SCIENCE AND FAITH

HUGH W. SANFORD

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SCIENCE AND FAITH

OR

THE SPIRITUAL SIDE OF SCIENCE

BY

HUGH W. SANFORD

AUTHOR OF

"THE BUSINESS OF LIFE"

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IN TWO VOLUMES

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NEW YORK · G. P. PUTNAM'S SONS · LONDON

The Knickerbocker Press

1930

SCIENCE AND FAITH

Copyright, 1930
by
Hugh W. Sanford

Published, Fall, 1930
First Edition

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Made in the United States of America

Since this volume uses Philosophy as a means of criticizing Science, and the findings of a corrected Science as a means of establishing a Philosophy, I dedicate it to the most perfect natural philosopher I know,

MARGARET W. SANFORD

THE TITLE

In my latest work, *The Business of Life,* I stated that the title of my next book would be *Life and Matter in the Light of Evolution.* I here offer the book to which I then referred; but, on account of its rather deep religious implications, I feel that the new title more adequately conveys to a prospective reader the nature of the contents. Indeed, so much does physics depend upon the activities of an outside spiritual Cause for the rhythmic movements in the mechanical fluid with which the scientists deal, that a better title might have been "The Bases of Religion in a Corrected Science," or, perhaps even, "Science Becomes Intelligible, when Interpreted Spiritually."

The mightiest manifestations of active force flow solely from Tao. Tao in itself is vague, impalpable,—how impalpable, how vague! Yet within it there is Form. How vague, how impalpable! Yet within it there is Substance. How profound, how obscure! Yet within it there is a Vital Principle. This principle is the Quintessence of Reality, and out of it comes Truth. Tao produces all things; its Virtue nourishes them; its Nature gives them form; its Force perfects them. . . . The World has a First Cause, which may be regarded as the Mother of the World. When one has a Mother, one can know the Child.

The Sayings of Lao-Tsŭ (about 600 B.C.)

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CHAPTER I

UPON OPENING AN UNEMOTIONAL VOLUME

Can I express in a few pages what is insufficiently done in many? Unless a beginning implies more than is later proved, or consciously sets forth the controlling idea, or presents some apology, or appreciates the aid of others, perhaps it should not be. Nevertheless, my beginning is to be only the first—an attempt to suggest more than is proved.

Poor mechanical facts! They contain no ideas, yet we try so persistently and hopelessly to wring ideas from them. So rigidly related they are to things, to particular things, to solid things of definite dimensions! How then may they contain ideas? Ideas grow in only one field; and it becomes alive and green when we regard, not frozen findings, but that Evolution in which the solid loses some of the dimensions of which it was so sure and proud—and is made anew. In Change, matter sheds tiny parts of itself, and these, transformed—matter no longer—emerge into the world of ideas. Ideas appear as substance evaporates; and it is their province to realize Change; to measure it; and, finally, to prophesy whither it leads.

Are considerations of fact useful, then? Not if one insists that average facts are indeed changeless! They *are* useful, however, to him who, believing otherwise, wants to discover the laws of significant Change; who wishes to plot a terse scheme of evolving life; who wants to grasp the influence on mechanical routine of this Time-consuming process of

Change. For such a one it is logical to measure the thing of the moment with exactness, and then, after being quiet for a time, to take its dimensions again. If one has been precise enough, the shrinkage in the boundaries of fact may be calculated, and the rate of Evolution determined.

Facts have their place, then, even as they change, for those who desire to express routine mathematically. Emotion, however, has its place, too, and perhaps a grander place. A wide-sweeping glance often tells more than the closest inspection. Who can understand the world by forever observing its details through such crude microscopes? Or, what understanding of the Evolving Spirit can be had from the use of any rule or compass whatever? Surely the nature of Spirit is realizable only by Spirit!

May we, then, glimpse the nature of moving Spirit, or understand its becoming, or even prove that matter and its facts are evolving?

In order to attempt such proof, may we use letters, themselves facts,—crisp, single, and seemingly changeless? These marks, with measured beginnings and endings,—with no blurs anywhere, or haze to show that a fact has fused with Spirit,—whether twenty-six or twenty-six thousand, can they speak for us here? Do these motionless witnesses ever describe more than what is changeless and unmeaning—like lead resting heavily? Are letters more than facts themselves? Let us see.

We have the emotion of Change, of change through motion —motion which, undisturbed, runs in straight lines! The most extended sheet of matter could not for ever hide the slightest expression of such motion. Matter must be spread even to infinity itself—infinity, which is neither fact nor idea—if persistent motion is not finally to emerge. That which has a portion of deflected movement in it may therefore speak for us, for it tells of an Evolution which is real, of a making and being of Spirit, of everything which is not inert fact, and which fact cannot conceal.

Have letters motion in them, then, that they can tell of the creation and being of Spirit? Unless they do, unless they have the movements of thought in them, a spiritual essence

in them which is not fact-made, an emotion in them which is not the inertia of matter, they can be spread even endlessly, and yet express no more than materialism and futility.

Or can words do more—words arranged according to rule and formula, with commas, colons, and periods between, and with exclamation points, and dashes, and question-marks? Can innumerable libraries ever transcend the particulars of man's life with things, and express a little of that which essential life reveals—of realms where not things are important, but Spirit, and that Change in things whence Spirit arises? Or, should we, like the beggar-saint of Hindoostan, renounce the word, and physical facts as well, and sit seven years in meditation, in inner recognition, in hope that the soul will of itself expand?

These shining metaphors of the mind, these inherited symbols representing the ideas of our race, these words, do they transcend, then, these atoms burdened so heavily with physical routine? Surely, if our words are to be for ever mechanical there can be nothing in man but physical automatism, and in him no jot of Beauty, of Emotion, of inner Significance, of Power, of Free-will, of Godliness! Shall we thus interpret our word-metaphors, their music, their flow and meaning, their ideas and their symbols? Shall we thus interpret ourselves? All change cries "No!" How could our idea and appreciation of Change exist, were this true? All instinct answers "No," and all desire!

No! A procession comes from out the vagueness waving banners that shout their "No!", Keats and Shelley and Swinburne leading the singers, with Homer, Goethe, Dante, with Shakespeare, Milton, and Rossetti,—phrase here and poem there,—and with Walt Whitman and his turmoil of sound and meaning. All these and thousands still—Plato and Emerson and Nietzsche doing their part—have pierced tiny holes in their shells, and like the Brahmin and the Buddhist, the Yogi and the Theosophist, the Christian and the mystic, the neurotic and the hypnotized, like those in trances and those in dreams, or epileptics, or those anæsthetized, or like those who, this way or that, have somehow escaped from body-thoughts, and have forced ways through the barriers

of the earthy, these unusual ones have seen through into realms beyond their bodies; and some of them, with words—the symbols of men—have passed on dimly to us dullards a little of their transcendent vista, a little of their thrill and ecstasy.

These seers and masters have used letters, words, rhythms, and the sounds and inner significances of words, symbolically and directly, to convey meanings which one might have supposed no words could contain. These inspired ones have perforated their materialistic selves, and have emerged—if but a little distance—into the spiritual beyond. They give out their pulsating sentences, and Spirit is revealed!

Oh, to feel keenly the waves, the rhythms, the colours, the tones and movements of words as they beat on the senses! To realize intensely these undulations of meaning waving off into the distances. What marked intensifications beyond ourselves these quiverings stretching past the confines of the physique, these emotions reaching to and sharing in the great Without, partaking not of worlds of matter, but of the spaces between; partaking not of the dead and inert, but of that above and outside the inert particles; partaking of the alive, the moving, the all-pervading Power that does with us usually as with globules of water or with atoms of sand! Appreciation of this, put into word-rhythms by our great ones, stands there on translucent sheets,—filmy inky outlines, yet the means of dim glimpses beyond!

But beyond *what?* Beyond our physical self, the self of us that eats and drinks, that sleeps and bathes, and goes through the regular routine of things impinging upon things. Reach out of our particular, expected, mechanical trend, we must, if we are to realize anything that stirs or elevates or inspires! Express somehow we must our thought which is spiritual. Express it as freed and released from mere ego and its needs and prides. Let us shake loose hampering matter as the dog shakes off water, and escape from the vice-like grip of things, things with mechanical properties and functions—yet with that mysterious routine connoting Change!

Let us get away, then, from blood-vessels and veins, and bones and tissue, from houses and walks, and doors to be closed, and squeaking hinges, and windows that are mechanically transparent; from trains, and rushes and flickers and poundings; from smoky compartments and cinders, and from stops and starts that jar! Away from desks and contracts, and dollars, and sales and expenses, and the income tax! Away from flying belts and pulleys and punching-machines and freight-cars! Escape! Escape we *must* somewhere, somehow, to the idea, to the symbol, to the beauty, to the universal, to the life between things, to the glimpse of the Absolute, Brahma, Buddha, Tao, The One, Logos, the Cause, God—to the soul-in-itself, to something so difficult to describe in hard little letters and words with commas properly distributed.

We realize that something shines there far more sublime than the halting words we use to tell of it. The blue sky, its depth, its grandeur, its haze, its far meaning! Then the creeping-over night, the night that moves, and is bluer still, then purple-dark and mysterious and satisfying, while the shining stars come out, and the serene moon glides, and a quick meteor darts—and, then, the inexpressible is somehow after all expressed.

So with the bosoms of the oceans, forever stretching, with waves that rush in upon themselves, and waters forever undulating, and always bearing witness, while the sun rays flicker off their crests, and a dolphin rolls—and then utter vastnesses.

So with the ponderable mountains, from the crags of which wild goats jump, and on which tall firs grow. Some are covered, wrapped in snow, with occasional bare grey rocks jutting skyward, while foreboding avalanches crash, and glaciers majestically slide and crush and push, and slowly mould the warm valleys. Change, significant, Absolute Change, and the emotion of Change, is there—outside of us and acting upon us, who, too, are changing! And some peaks are burning hot, with spitting flames and sulphur fumes and gliding lava streams—all motions and emotions of Change! But others are alive more peacefully, with trees and herbage,

and trickling springs, and brooks downrushing over rocks worn round by Time and Change. How little the meaning of this is expressible in words!

And we have flying birds, and music in the air, and flowers growing placidly in gardens, and wild violets peeping out from woodland leaves. And there are lilies in the fields holding themselves upright in the sun, and the crane standing in ponds, balancing on one slim leg, and elephants in jungles flapping ears; and the whispering canebrakes in which tigers huddle. And there are filthy pools which ooze and glister, and green scum in which beady-eyed snakes slither along. And there is the uprush of the trout to the waterfall, snapping an iridescent tail, and the leaping tarpon,—and the bounding pulse as well,—and the sly cuttle-fish, and the inky squid. There is all nature, doing and moving and trembling and shaking and rotating and quivering, and sending and exchanging, and meaning something to us and to God, even to the remotest of its farthest spirallings.

For Emotion everywhere emerges from Motion! There is Bach with crashing bass harmonies, and Beethoven with his *Moonlight Sonata,* and the haunting pathos of his *Pathétique.* There is the graceful minuetto, denoting dance and love and stateliness. And Butterfly waits, singing the night through, and the boy on the floor in the morning with his oval eyes, waves his little flag,—waving his mother's life away. And there is the shriek of the Valkyrie, and the exultation of Scarpia, and the fight of Siegfried with the dragon. There is the love-death of Tristan, and the meditation of Thaïs, and the song of the Evening Star, and the chanting chorus of the marching pilgrims, and the sublime majesty of the *Götterdämmerung.* And there is the march to the Holy lands of the pilgrims, and the Faith in something which is greater than music, and from which music comes.

Then there have been the harder motions and emotions of thought. Cunning thinkers, deadly thinkers, some of these, but mostly observers of rules and routines, and believers in enduring Conservation. Let us leave them all the more quickly because there have also been nature-philosophers and mystics and dreamers.

There is a temple of Buddha, and a Sphinx in the desert, and a holy river of the Ganges, and a holy city on its bank. There are dreams here, and mysteries, and glimpses without. There are Love, Hope, and Ecstasy. There are passions and strivings; there are eyes closing dreamily, and wrinkled contemplations; there are the flashing glance and the dragging foot. There is the far depth of the grey cathedral while the organ moans, and there is a dance in the sunlight to the tinkling harp. Yes; there are meanings and symbolisms, and incantations, and musings, and laughter and tears together, everywhere. And all reach out to something,—emotionally out!

Motions and emotions come from the very stones. The marble block is shaped into a finer significance. Cold, chastely white, it implies the sublime. The tapered spires, the jutting peaks, point somewhither! The twisting snakes of the Laocoon twist with some avail! For Phidias has lived; and Michael Angelo has carved his *Pietà* and his David. So grief and joy, laughter and tears, and hate and greed and kindness, and boding mystery, and *faith,* have all looked forth convincingly from cold, inert limestone.

And Leonardo has painted unto heaven, and Raphael has followed. There have been Titian and Tintoretto, and Beatrice Cenci, and the Fornarina, and the buxom wife of Rubens, and the sunsets of Turner. And the brown tints of Rembrandt have softened our lives. In canvas and in colour there have appeared, from the hand of genius, love and grandeur, depth and sublimity. And one has painted the deep blue sky with evening stars brooding in the depths, and the cold petrified snow gazing back at the stars, and the shadows in the twisted rocks—shadows of rocks that might be leopards and snakes and lions—and the row of fir trees leading towards the stars, while the avenue of firs disappears into the purple haze.

And there is friendship and its inspiration. The unexpected kindness, and appreciation, the binding-together into a larger and tighter whole. And the love which passeth understanding, so far beyond words—it, too, we know.

All these, and all escapes from the bones, hair and muscles and vanities of the body, make for a dim realization. As Sydney Lanier has said:

"Haply we know somewhat more than we know."

We know that we partake of the universe—not the universe of cold, dead things; but of warm, living, moving ideas. We feel it, we sense it, we vaguely grasp it, we strive to get hold of it, we, poor pitiful beings, living mostly our lives of the body, with its weighted leaden limits everywhere.

Yes; there is so much more than our logic reveals! This feeling into the outside, these emotions from motions, these sensings from sensations, even carry us through the clammy mud and cold waters and burning fires of life, and its pains and tortures. We know dimly what we might be, but we know that we can be it now but partly. A power within us has its problems with our little skeleton bodies; yet we feel, somehow and at some times, the bigger problems and the bigger relations of this power. In our motions and emotions, in our changing lives, in our sway over our bodies, and over the things which now are actual about us, we realize the presence of something more than matter—something that has motion of its own, and even the power to produce Change in solidities, and, therefore, to give us significant life; something that is doing and accomplishing; something that is universal and Divine.

If we could but dream more, instead of forever doing! If we could but let go, forget our bodies and their daily demands, dismiss them with a wave of the mind, and, trance-like, soar away into the mist! If we could but recognise the transcendent quality within us, and escape some of the daily physical routine! To dream, to sink in, to be imbued with the subtle unconscious, that something which is within us, but which forever escapes, which hides in dark corners, which just misses being grasped, which dodges behind walls, which we cannot isolate, but which we can so dimly sense, so vaguely know!

Let us wander off into space then, with the musicians and the painters, with the poets and the mystics and philosophers

leading the way. Behind these sensitive ones, but ahead of us if they like, may come the matter-of-fact shrewd ones, the blustering noisy smashers, the penetrators, the blow-givers, the mighty and powerful doers, the stubborn, the egotistically conquering ones, the Napoleons and Alexanders, the Neros and Cæsars, and the Greats named Frederick and Alfred and Charlemagne. Let them come in their own imperial dust, perfumed with themselves, and with their own driving energies and ambitions, with sweat and clanking armour. Yet some of these seem dejected quite, and epileptic and queer, even in the glitter of their proud eyes and in the poise of the thrown-back head.

But let us humble ones come likewise, and dream ourselves into that haze where dreams become realities. Let us escape from the bonds of materialism, from the hand-cuffing bands of steel, from the iron chains of weight. Let us overcome inertias—as we can—and dominate mere cohesions. Let us fly this world of three directions—these three meaningless directions which are merely length and breadth and depth! What are they, indeed? Nothing but deadness, sameness, mechanics, meaningless routine; nothing but fetters of stationary fact holding us tied to deadness. Nothing are they after all.

But how shall we gradually acquire our wings for such flying, our impulse for dreaming ourselves away? We must build them out of spirit, out of thought, out of the hidden meanings in poetry, painting, sculpture, and music. We must glean them out of words and letters, out of symbols and metaphors, out of these motions of spirit that signify real change, out of the inner quality of that which governs us and the universe and the immense of space. Such ideas may be built well and high on Evolution, on significant Change taking place in Time. Together, these will finally leave behind no materialities, nothing that is inert and of itself meaningless and sordid. Let us first grasp the *idea!*

The dimensions of substance shrink and wither in the acid trickling of Evolution, which trickles here and there unperceived, but which is really a mighty flow. Within Time there is mechanical movement. Within Time there is spiritual

Change. Time, because of what happens within its borders, is more than deadness. Time incloses that which is more than matter, and more than its inertness. Time is significant —not because it is real in itself, but because it imprisons that which is more than substance, that which even evolves solidities. Time incloses Evolution—a change significant indeed because it is not reversible. In this we behold the grandeur of Time. Matter ceases entirely to be under the rays of its dissolving principle.

A fourth direction—and we may call it this—appears in and between mere expressions of substance! Spirit has appeared, and is appearing, even out of inertia. This we know; this we feel and sense. This is our emotion, and this is our greatest reality, because Evolution means the changing of matter into soul, because Evolution exists in Time, and because Art and Beauty, Motion and Emotion, exist in Evolution. This, indeed, is our whole faith, our entire message, and our only sermon.

The ever-appearing spirit-direction, the disappearance of the old three physical directions, and the materialistic motions and emotions that go therewith, are everything! Because of this, Life, and the feeling of it—the subtle idea of all that Evolution and its new directions are—are real, and are partly appreciated and occasionally expressed by the great artists when the spirit within them has escaped from its prison of material facts, and has communed with the Spirit that moves the universe. Because of this, our artists are the great ones, and we, with our humbler means, can imitate but feebly. We can but vaguely suggest our message. The brook of Change flows on. Can one ever picture to men the almighty flow of it? Or, must they feel it of themselves?

Have I now at all expressed the thought of the greater number of pages in these fewer? Doubtless no, for I am a tight particular, a physical unit, like my fellows. Only seldom will the average you and I be attuned to

> "That Light whose smile kindles the Universe,
> That Beauty in which all things work and move,
> That Benediction which the eclipsing curse

> Of birth can quench not, that sustaining Love
> Which, through the web of being blindly wove
> By man and beast and earth and air and sea,
> Burns bright or dim, as each are mirrors of
> The fire for which all thirst. . . ."

My attempt to suggest my meaning is, of necessity, inadequate. You and I, perhaps, need particular words, paragraphs, chapters, and tables of contents. We need references to others, quotations, similes, and analogies. We need the syllogisms of logic, and mathematical forms and equations. We need words derived from Latin, and words of more than one syllable. We need a prescribed routine, and a particular order and sequence. We need facts, and an attachment of fact to fact. We need to prove that the fact in the foreground belongs to the fact beyond! Only immense inspiration can depict the relation of the general with the particular without using many connecting particularities.

Let me proceed then in the dull routine way, in the way that suits us best, by the routine of particulars. A equals A; A does not equal not-A, and so on. Sir Francis Bacon has given me the skeleton which I must clothe for the museum if it is to be exhibited. The broad glimpse, the mood, the emotion, is not for me. Let me betake myself, then, to the microscope and observe some little parts of our world. Perhaps that's the best way, after all,—for all of us. Perhaps emotion will finally fall before the syllogism and the microscope. Perhaps even Beauty and Goodness can be analyzed, and explained mathematically! Perhaps!

Hugh W. Sanford.

Knoxville, Tenn.
June, 1930.

CHAPTER II

DESCARTES INTRODUCES THE PROBLEMS IN GENERAL TERMS

A shipwrecked sailor buried on this coast
Bids thee take sail.
Full many a gallant ship, when we were lost,
Weathered the gale.

Taken from "The Greek Anthology"
by Mrs. O. W. Holmes.

An Imaginary Conversation in 1636 [1]

René Descartes, born in 1596, was a sceptic. He doubted knowledge that was not proved true. If some one at the tavern had remarked that his home was cool in summer because elevated several thousand feet, Descartes might have amused himself by quizzing the stranger. Such questioning was valid then—and still is. It might be interesting to listen to an imaginary inquisition by Descartes.

D. I am glad to learn that your mountain is cool in summer, but I am curious to know more. This heat that warms us, whence comes it?

S. The sun, of course, supplies most of our heat. Some may come from the earth, but surely that which principally accounts for the difference in temperature between mountain-top and valley radiates from the sun.

D. Yes, the air about me is hot because the sun heats it. Air is not hot or cold of itself. Or, at least, its heat is not created by a power within itself, and cannot be given steadily to anything else unless new heat is acquired from an outside source—the sun no doubt.

[1] The reasoning in this chapter is somewhat abstruse. It outlines in general terms some of the subjects that will later be considered more in detail.

S. You are right. Air is *not* an original source of heat; it receives the excess of heat which it delivers.

D. If this be so, why might you not remove part of the air without lowering the temperature? Why, then, on the mountain, where you are closer to the sun, are you not hotter instead of cooler? Why does not the temperature rise as you approach the source of heat? Of course, a few thousand feet up more or less makes no appreciable difference in the distance from the sun, but why are you distinctly cooler when higher?

S. The density of air *does* affect its temperature. I am cooler on the mountain because the air is thinner, and therefore cooler, at the higher altitude. That is the fact, however it may be explained. Why the air is cooler when thinner, I do not know.

D. The mystery is as deep as ever. We have agreed that the air is not itself an independent source of heat. Hence, neither its thinness or density, nor its own natural quality of heat or cold, should have final thermal effect upon another object. Indeed, there is no particular reason why your body should not receive its heat directly from the sun, just as the air does. Before we can reason much more about this strange phenomenon, we must first consider the nature of heat. What is heat, my friend?

S. The mechanical energy-series known as heat is supposed to be transmitted from the sun through wave-vibrations of ether.

D. What, then, is ether?

S. I am sure I cannot describe ether. Scientists tell us that it is an imponderable continuum filling all space; that it has neither mass nor inertia. No one has ever detected physical qualities in it. It seems to be merely a filler.

D. Ether, then, is nothing like air, for air has mass and weight, and is composed of discrete atoms of the ordinary type? Air is not a continuum.

S. No; there is no resemblance between ether and air. They

are as different in quality as sweetness is different from tallness.

D. And you are sure that ether-waves, and not air-molecules, transmit the heat-sensations that reach us from the sun?

S. This is the accepted theory. Air-vibrations could not continually deliver energy-vibrations to something without themselves losing energy, and thus without becoming colder and colder. And the air zone does not extend far towards the sun.

D. And ether is supposed to be everywhere?

S. Yes.

D. Then, let me ask, are the ether-vibrations reduced in number as the quantity of air is reduced?

S. No; and I grant you in advance of your obvious question that there are approximately as many ether-vibrations at one altitude as another. Certainly the thinning of the air does not increase the amount of ether importantly.

D. Then, if heat were really the effect of an ether-wave, the higher altitude could not display a lower temperature. That being so, it appears necessary to assume that heat is delivered by air-waves, and that I become cooler as, and because, the quantity of air diminishes. Air must be the medium which transmits ether-vibrations to me. I cannot receive heat-energy directly from the ether, but do receive it from the air after the ether-waves have affected the air.

S. But how do the ether-waves affect the air?

D. It is you now who are anticipating my question. If ether has neither mass nor inertia, as scientists claim, how can ether-waves affect the air more than they affect my body? Can something with no ability to express conventional momentum deliver a blow that might impress any physical structure? No; while the facts seem to indicate that the air does act as the medium between ether-wave and me, even this does not explain how the ether, with no inertia of its own, gives a moving

blow to the air-particles! It seems impossible that the air should be affected by ether-blows.

The physicist will probably tell you that the interaction between ether-waves and the particles composing all atomic structures is similar to the interaction between an air-wave and a piano string. When the air waves are undulating at a certain number of vibrations each second, the string which has this same natural period will start vibrating under the influence of this air wave. Well enough! This can be understood for the air-waves deliver a mechanical blow. One only of the air-waves will start the string moving, but a succession of them in proper beat will soon have it vibrating vigorously. When the air-waves are received at the natural interval of the vibrations of the piano string, the second air-wave will not interfere with the movement induced in the string by the blow of the first, but will supplement and enlarge it. When, however, the string is struck at some different interval by air-waves, each succeeding impulse will likely destroy all or part of the motion created by the preceding one, because the two movements will likely be in opposition. On this account, a piano string with a natural interval of vibration different from that of the series of beats of the air-wave will never build up a perceptible vibration under the influence of such waves.

This principle is understandable, for an air-wave can deliver a blow of the usual type, and can start motion in the usual way. It can also offer normal resistance to opposed motions. I cannot see, however, how this explains the delivery of wave-motions to inert matter by an imponderable ether, for ether-waves are not supposed to be able either to deliver mechanical momentum or to offer resistance to motion. Indeed, I should not be surprised if, when scientific instruments are more perfect, it will be learned that many phenomena take place according to principles contradictory to this illogical ether-wave theory.

S. I admit that your reasoning seems sound. There is

something mystifying about this; something that has not been thought through.

D. Well, let's drop this mystery and develop another. What is sunlight?

S. Why, sunlight, also, is supposed to result from ether-waves that come from the sun.

D. Is the sunlight less, as the temperature is less, on the mountain than in the valley?

S. No, the sunlight is stronger at the higher altitude.

D. Doesn't it seem strange that both light and heat should come from the sun, that both should be derived from ether-waves, and that light should be stronger on the mountain than in the valley, and heat less strong? Isn't this particularly puzzling when it appears to be impossible that either light- or heat-waves in ether might affect air, or the human body, or any physical matter?[1]

S. Yes. The more I think of it, the more extraordinary it seems.

D. I suppose you will not attempt to explain how a light-wave in ether can deliver an energetic effect to the retina of my eye—a physical film that surely must be subjected to the blow of a weighty mass before it can be affected?

S. No, I cannot begin to imagine how an imponderable ether can deliver a mechanical blow, or create any sensation-relationship.

D. But don't you see how impossible it is for ether to have mass? If it did, how could the earth plough through it sidewise for aeons of time without being appreciably retarded? What a mystery this is! These very evi-

[1] On the basis of an equally unreal and equally unexplained theory of light and heat transmissions by the medium of an imponderable wave in an imponderable electromagnetic field, the physicist of the twentieth century endeavours to solve this puzzle of Descartes by saying that "the energy of the electromagnetic waves is transformed into molecular action when the waves impinge on matter, just as a spark is produced when two flints are struck together." This, however, is not a satisfactory explanation. The two flints, furthermore, are both typical material composite structures. Both have inert parts. Not so the electromagnetic or ether-field-wave. The statement that "light-rays produce heat merely as a result of a transformation of their energy into one of another type (molecular agitation)," is not an explanation.

dent light- and heat-energies streaming from the sun, how can they be transmitted as ether-waves? And how can these energies be delivered as blows from an imponderable medium? And if ether (or heat or light) can deliver momentum, why do planetary motions continue through it at approximately steady speed? How are we to explain these contradictory facts? I think we must end by admitting that the natures of light and heat—as well as the source of their abilities to affect the physical world—are unknown. In unity of truth there can be no such contradictions.

S. I agree with you there.

D. Well, if light, heat and ether are mysteries, what about other phenomena? What may one say about gravitational force? What is *it?*

S. Science does not pretend to understand the real nature of gravity. Merely its laws have been discovered.

D. I doubt if scientists know even how gravity acts—the *real* law and nature of its actions. May I ask you some further questions? If you know anything of the true nature of gravitation, you can tell me at least whether it is continuous or intermittent. Now which is it?

S. Surely, the force of gravitation acts continuously. It never stops. This much I *do* know.

D. You mean, then, that the book lying here on this table delivers its weight-energy of two pounds *constantly* to the table?

S. Yes. Mechanics and its working formulas are founded on that assumption.

D. I agree that the physicist will *tell* you that the book constantly weighs two pounds, but I wonder if he is correct. It doesn't seem reasonable.

S. Why not? It seems entirely reasonable to me.

D. This is what I cannot understand. If the downward force of this book is indeed continuous, constant, never ceasing, mustn't there also be a similar and continuously expressed force upward sufficient to resist the weight of the book and thus able to prevent the book

from pressing down into the structure of the table? It would seem that either the table must push the book upward as continuously as the weight presses it down, or else (when the table *does* push up, every once in a while so to speak) the push must be hard enough to overcome the entire accumulated tendency of the book to fall downward—a tendency to motion which, we have assumed, is expressed without cessation. Now, I can't understand how either happening might be possible.

In the first place, we know that the atoms of the table are discontinuous. Hence it is impossible that their blows should resist the weight-force *continuously*. The separated atoms of the table, moving up and down at intervals like waves in the sea, cannot deliver a continuous blow upward. They cannot offset without cessation the weight aggressions of the book. Indeed, the molecules of the table support the book just as the air-molecules of a balloon support a weight upon it. Not internal repulsions at a distance of the air-molecules in the balloon cause their renewed intermittent beating against the cover, but thermal motions, it is said. Yet the weight is supported through these blows delivered at intervals. But, passing by the puzzling question of the cause and nature of thermal motions (and the source of their energy), I ask you again how the *discontinuous* internal energies of the table can possibly balance a *continuous* gravitational force?

S. I am willing to admit that the separated atoms of the table do not give an unceasing upward shove. The wind blowing against the sail of a boat might deliver energy that appeared to be continuous, but surely this force would be due to the separate blows of air-molecules. Hence no one could claim continuity for it.

Indeed, I now perceive that if gravitation *is* continuous, the book must vibrate through a slight distance—first falling, and then being restored to its old position by the intermittent blow of the molecules of that structure which it compresses and which supports

it. I therefore admit this fact of vibration—however different it is from my old view—but I still do not see why you find it difficult to understand that the continuous weight-force might finally be balanced and offset by discontinuous blows.

D. Let me try to make this point clearer. You assert that weight is continuously expressed energy—that the effect, the push of weight, is delivered without intermission or cease. You mean, then, that the weight-force of this book, known as two pounds of weight-force, is *delivered fully* during every smallest imaginable time-interval. An energy equalling two pounds of weight-force is fully bestowed, then, during each trillionth-trillionth part of a second, and again during each trillionth part of that, and so on as far as you like until the time-interval approaches zero time. Either this is true or else the full weight-force is *not* being delivered continuously. If the full effect of the two pounds of weight is *not* expressed in a trillionth-trillionth part of a second, then the weight-energy of two pounds has *not* been actual during that small time, and is therefore unreal for that interval as two pounds of weight-force. Only that force which *is* effective during a certain time-interval is real for that interval, and if less than two pounds of weight-force is expressed during this small fraction of a second, more time than this will be required for the full two pounds of weight-force to be effective—and thus to be real. Yet, if more than some certain small interval is required for the two pounds of weight-force to be real, then the two pounds of weight-force has not been continuously real. During certain bounds of time there has been no possibility of such full delivery of force. And yet, for the two pounds of weight-force to be real *always,* it must be expressed to this full limit during the most infinitesimal period of time.

Let us now look at this from another view. If weight-force equalling two pounds were fully expressed during each infinitesimal unit of time, then, let us ask,

how much weight-force would be expressed in one whole minute—an interval of time which contains an infinite number of these very small time-intervals? Why surely, the answer must be: "An infinite energy." I cannot agree with the viewpoint of the mathematician (taken because of the necessity of having a practical formula and not because it was reasonable) that the multiplication of an infinitesimal quantity by an infinite number (both irrational) can arrive at a product having finite, and, therefore, rational value.

S. You are certainly developing an intellectual quandary. As you say it seems necessary that the amount of energy expressed by weight must have some relation to the time-interval in which it is expressed. More weight-force is expressed in ten seconds than in one. And, working backward, if we divide our time-interval sufficiently we shall reach some very tiny period during which no weight-force is expressed. Otherwise, as you say, the weight-force of even a whole second would be infinite. Yet the force of weight is far from infinite. The more I think of it, the stranger it seems. What belief shall we surrender? If gravitation is not a continuous force, what is its interval and unit? And if it has an interval, what is the nature of that which makes it intermittent?

D. Consider the case of a ball kept in average balance by the upward blows of the separate and discontinuous drops of the spray of a fountain. From the standpoint of reason, a continuous force, as weight-force is supposed to be, is necessarily unlimited, and cannot be counteracted on the average through time by a discontinuous force which *is* limited. And the weight of the ball represents just as large a total of expressed energy during a certain time whether or not the ball oscillates slightly on either side of an average position or neither rises nor falls perceptibly. So long, furthermore, as the ball ends the interval neither higher nor lower the entire downward weight-force of the interval must have been exactly compensated by the forces of resist-

ance. The idea of a continuous energy-delivery leads, therefore, directly to the concept of an infinite energy —to an energy-expression certainly that could not be fully compensated by the separate and limited blows of the drops of water. Then, when we try to subdivide infinite or continuous energy into parts that might either be expressed or compensated during separated and limited time-intervals, we arrive at inconceivable concepts.

Speaking in general terms, how might there be continuity in mechanical relationships in a world distinguished by the fact that its matter-particles are separated? And how can "attraction" be continuous in a universe wherein counter-balancing forces (those of inertia) are expressed discontinuously? Surely, continuity cannot be associated relatively in any way with discontinuity. They cannot act against each other in any given ratios, or be used to balance each other! Indeed, they are entirely different principles as distinguished by our reason. They can be no more definitely related than an infinite number can be definitely related to a finite number.

S. That is hard for me to grasp. First I think I have it fast, and then it slips me again. I suppose I have always been accustomed to regard weight as a continuous energy-expression, even when the weighty mass seemed to be held motionless in the average, such as the book on the table, or the ball on the fountain, and I am having difficulty in breaking myself of this mental habit.

D. Sometimes it helps one to think of a proposition like this in reverse—as a cause rather than as an effect. Think, for example, of an engine driven by exploding gases. Each explosion (taken as an explosion purely and neglecting the expansive forces) displays a certain amount of power, and permits the engine to do a certain amount of work.

Let us now suppose that between explosions there is no energy-expression—that, when the work of one

explosion is done (and we may assume that it is done instantly), and when this energy has actually been expressed and made real, no more energy will exist to be expressed until the next explosion. We now come to the helpful idea. Think of the number of instantaneous explosions required to express explosive impulse *continuously* against a piston which may vibrate slightly, but, which, in the average, moves no more than the table moves from hour to hour under the weight. You will doubtless agree that an infinite number of such explosions would be required to express an unceasing impulse against the piston, and if each explosion *does* exert *some* power, then the continuous impulse (the product of infinity and a real quantity) would represent infinite power. No piston that did not also offer infinite resistance could resist movement when thus attacked. The concept of a continuous force obtained through blows inevitably leads us to the idea of an infinite force—however tiny each blow may be.

S. Yes, that thought helps me.

D. Or, let me put it differently. Suppose gravitational force were caused, not by an attraction, but by blows of invisible corpuscles striking downward towards the earth. This might well be the case, and, so far as the results were concerned, none of us could tell the difference, just as no one of us usually realizes that the pressure of the wind against the sail of a boat is discontinuous. Each gravitational corpuscle would then deliver a certain amount of momentum of the usual kind. All weight-force, like that of the ball on the fountain, would be expressed intermittently, even though the weight appeared to be unceasing. In such case, whenever, in the average, two sets of impulses in opposite directions are balanced, and whenever the total momenta against an object during each second from opposite sides equal each other, the object will stay relatively motionless, hour after hour. All the downward force would be offset by an upward force

of similar kind, and we should observe that balanced state of affairs which does obtain.

S. Yes, that is a very clear illustration. I can see that the *effect of weight-action would be just as it is if gravitation were due to a series of very tiny and very rapid intermittent blows.* I grant you, too, that to obtain a continuous gravitational pressure through the use of the blows of moving particles, an infinite number of energy-delivering contacts of particles each second would be necessary, and an infinite force would then needs be expressed.

D. You have conceded everything: If gravitation were due to the blows of separated corpuscles its force could neither be infinite nor continuous. And yet an "attractive pull" less than infinite cannot accomplish something that its opposite, a "push", cannot attain without arriving at infinity. The force-units of the two take identical places in the mathematical formulation. Any force unceasing in its power-delivery, therefore, must be infinite, whether it be "push" or "pull". Yes, the opposition of intermittent and finite forces can fully explain the seemingly balanced ball on the fountain. We have no real reason except the seeming appearance of a gross perception to suppose that weight-force is continuous. If weight-force were intermittent through an interval too small to be perceived, the results would be exactly as they are. Then, again, we find that the more we increase (imaginatively) the number of these force-expressions, whether "pulls" or "pushes", the smaller each must be. And when we try to conceive of an unceasing (or infinite) number of "pulls" or "pushes", we discover that each of them must be infinitesimal in its force-expression (that is zero), or else the total force-expression will add up to the inconceivable infinity. In this philosophical dilemma, we must accept the only idea acceptable to reason—namely, that weight-force is intermittent. There is no reasonable alternative; and the assumption

does no practical harm. Our working rules will remain much as they are.

S. I am now ready to admit your contention that gravitation is not continuously expressed energy. I admit also that we have had no right to suppose that we know its true nature. We have merely formulated some of its expected influences through gross periods of time. And while we have assumed from comparatively large experiences that gravity *was* a continuous force-expression, we have failed to develop this idea *philosophically*. Gravitational acceleration also was determined by inexact practice, and not by theory. And our concept of gravitational force has been set up as the amount of force that will within a second give a body falling from rest a velocity of about thirty-two feet a second. We assume one set of facts (continuity) and use the results of another set (limited force) in our rules—and thus we save our skins and our argument, so to speak. We make our mathematical rules (such as the rule that the product of infinity by an infinitesimal may be anything finite that we want it to be) fit our supposed facts. We are crude generalizers, loose thinkers. We have believed that gravity was continuous merely because our perceptions have been so gross that we have been unable to appreciate those intervals during which no gravitational force was being exerted; and we have entirely dismissed from our minds the unreasonableness of the idea of continuous but limited force. We usually deny the reality of that which we cannot feel, see, or otherwise become aware of through relatively gross sense-impressions; and we incline to accept almost any inconceivability provided that it seems to fit in with our generalized experiences. We have sensations (experiences) only with certain types of phenomena,—the relatively gross, the composite, and the rhythmic,—and we have interpreted nature almost entirely from this one type of experience, and very little from pure reason. We have thus been led into misconceptions.

D. Another fact assures us that the nature of gravitation is misconceived. Gravity is supposed, is it not, to extend indefinitely into space, and to attract a body however far it leaves the earth? If you throw a ball upward, however fast, it is believed that gravitation will bring it back with the speed that it was thrown provided that it falls through vacuum.

S. Yes, this principle is generally admitted.

D. Well, the mathematicians prove it untrue.

S. What do you mean?

D. It may be proved by mathematics that a body starting from rest and falling towards the earth (supposing that the earth had no atmosphere and was isolated in space) from an infinite distance under the influence of gravity alone, reaches the earth at a speed of not more than seven miles a second. Particles of radium, however, can shoot away from the earth at a speed of more than twenty-thousand times this seven miles a second. According to the theory, the radium emanations should fall back to the earth, pulled by gravity alone, at this enormous speed—almost 186,000 miles a second. Why should they not return at the speed of their departure? Yet, if the theory is correct, and if gravity can pull particles back to an isolated earth from infinity at a speed of only seven miles a second, how can they be pulled back by gravity with a velocity twenty-thousand times greater? Must we suppose, then, that radiating particles might reach a point far beyond infinity? And does or does not gravitational attraction reach this super-infinity?

No; facts do not fit the theory. Either experience or judgment is in error. A definite experience, furthermore, proves that judgment errs. The intermittent influence of gravitation can be seen when a sufficiently small body is observed.[1] Tiny particles do not

[1] Known in later years as the Brownian Movement. It is explained in words as a thermal agitation, but the cause or nature of the agitation is not given. Its effect, moreover, is identical with that to be obtained from intermittent gravitational pressure—an effect visible only in respect of minute bodies. See Chapter XXIII, pp. 695–96. It does not seem to be due to thermal agitations, for the

remain stationary but jump up and down like fleas. Evidently they are first compressed by an external force, and then they are released and jump back as if resting on a compressed coil spring. What is true of tiny particles is equally true, when regarded for longer intervals, of the largest body composed of these tiny particles. At times gravity releases them all simultaneously, and then the body as a whole does not weigh. Only when an object is relatively large does gravitation appear to gross observation to exert an unceasing ability to hold it down.

S. Yes, I perceive that there is an error in the theory of gravitation.

D. And the fact that formulas give fairly correct answers and measures in physics, even while they include a supposedly continuous weight in them as one multiple, seems itself to prove that gravitation is not continuous, but that it is of the same general nature and kind as the discontinuous forces which it measures and balances. The Newtonian-theory of continuous attraction calls for impossible concepts. Reason cannot support it.

If, however, the nature of gravity is unknown, or misconceived, and if its expression against matter, or weight-force, is the measure of all the mechanical energies as set forth in the usual text-book, then the true natures of momenta and kinetic energies are misconceived, and the usual mathematical formulas probably contain important error.

S. I quite agree with you.

D. My friend, the science of to-day does not seem to be standing a perfect examination. Can we define Space and Time intelligibly?

S. No, we cannot.

D. These are interesting subjects, but let us pass them in order to consider something more personal. We think, do we not?

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beginnings of the movements are preponderantly anti-gravitational!—that is, vertical.

S. Yes.

D. What is thought? And where does it come from?

S. I do not know.

D. Your will can make your hand move?

S. Yes, certainly.

D. What is this will of yours which moves your hand?

S. It is indescribable. It has never been defined.

D. Is your will free? That is, can it act independently of a physical cause, or can it act independently *with* a physical object?

S. I do not know.

D. If your will is partly free, partly able to control the motions of matter, then the universe is dualistic, is it not? That is to say, there is more than the inertia of matter in it?

S. Yes, if one grants that "will" is independent of moving substances, and that matter, as such, expresses no appreciable "will", the universe can no longer be regarded as monistic.

D. You believe you have volitions and will, and yet you do not know what they are. You do not know whether they are disguised mechanical reflexes or attributes independent of matter. I suppose you believe that your life is continuous—that your thoughts, your volitions, and your personality exist and function unceasingly?

S. Yes. I have believed that during my life my personality never ceased to be.

D. How can the physical life,—and I mean by that the life that relates to the physical world and the contacts therewith,—be continuous if the matter of this world is composed of separated particles which strike and affect you only at intervals? I cannot see how this might be. Nor do I understand how your thoughts live in the Present, for the Present seems to become the Past before you can even think of it. And yet, if you cannot think in the Present, how do you really live in the Present?

S. I do not profess to be able to answer these questions.

D. Let us agree that you could not experience a life of sen-

sations except for the Past? But the Past is now finished and done with. Surely you cannot live now in something that no longer exists now, can you?

S. No.

D. Then you do not live now?

S. I am really becoming so confused that I am not sure what I think.

D. You do not know how you live?

S. No.

D. Do you know how you are conscious of yourself?

S. No.

D. You agree, too, that you do not know how life can be conscious of itself if the Present is not continuously under observation?

S. No.

D. You cannot explain Thought, Will, Consciousness, Heat, Light, Force, Gravitation, nor many other phenomena that I might ask about?

S. No.

D. What constitutes Beauty?

S. I do not know.

D. Justice?

S. I cannot say.

D. Can you tell me what matter is, or why it unceasingly moves?

S. No.

D. Now let us discuss something more concrete. Do you believe that mechanical action and reaction are forever equal, as the physicists claim?

S. Yes.

D. If this be so, what is the purposed accomplishment in the physical universe as a whole? How can there be any such phenomenon as significant Change, either permanent or temporary?

S. No, I must confess that I cannot explain these things.

D. And certainly there can be no Plan, nor Purpose, nor Volition, nor Will, to be observed in movements which consist merely in perfecting a reaction equal to the purely mechanical action?

S. I can't see room for these attributes in pure mechanics.

D. Yet, perhaps you believe in Evolution?

S. Yes.

D. Why?

S. I do not know except that it seems to be proved.

D. But Evolution is contrary to the doctrine that action and reaction are forever equivalent. Yet a perpetual equality between action and reaction is the necessary postulate of every motion, or manifestation of mechanical energy, is it not,—that is, unless mechanical energy is either destroyed or created during the action?

S. Yes.

D. The doctrine of the Conservation of Mechanical Energy implies, then, that every action has an equal reaction —exactly equal in every respect except perhaps at a different period of time and in a different volume?

S. Yes.

D. Then, if the Conservation hypothesis be true, "absolute" and significant Change, or Evolution, is impossible?

S. It would seem so, although I dislike to admit it.

D. But isn't mechanics based on the hypothesis that the Conservation doctrine is absolutely dependable, and upon the belief that mechanical energy can neither be destroyed nor created?

S. Yes.

D. Then Conservation is true?

S. I think it must be.

D. Then an irreversible Evolution, continuing steadily in one direction is untrue?

S. Monsieur Descartes, really I have reached a point where I do not seem to know what is true and what is false.

D. You admit, then, that your knowledge about everything is superficial?

S. It certainly appears to be so.

D. If I ask you questions that lead you far enough, you will soon come to a place where you must admit that you know nothing, and where reason seems to contradict experience?

S. Yes, I must admit all of this.

D. Hence either the premise is wrong upon which you have founded your reason, or the experiences upon which you have based your formulas are not as revealing of reality as they have appeared to be?

S. Yes.

D. Your knowledge relates, then, to a few unimportant little experiences upon which you have founded certain formulas, but you are not at all certain that your formulated ideas are correct in all cases, or even exactly correct in any one case, for you can give no conclusive reason for them, and you are not sure that your interpretation of the particular kind of experience is altogether perfect?

S. Yes.

D. For example: you have formulated the law of gravitation, but you have no idea why the gravitational "pull" becomes greater when the empty space between sun and earth is diminished; and your reason does not permit you to conceive how gravitation can operate both continuously and instantly, or through empty space?

S. I admit it.

D. You admit that you know nothing of fundamentals, and that what you vaguely thought you knew, seems now to be inaccurate?

S. I agree.

D. Now, my friend, since you have addressed me as Monsieur Descartes, I perceive that you know me. However, you may not be acquainted with my character. I am sceptical of the accuracy of most of the so-called knowledge of this age. I am almost convinced that the formulations of experience have not been properly or adequately set forth. The laws of gravitation, of momenta, of energies, etc., are formulations that have been based on certain types of experiences, and of course, in one sense, these experiences have been particular rather than general. They have related to that certain balanced state which here happens to surround us. The formulas, therefore, translate only the average conditions that prevail within the whole—and as rather

grossly viewed. Since these conditions do not appear to have been properly analyzed, nor their unit parts understood, it is doubtful whether the formulas apply with even fair accuracy to anything but those certain gross, or average, states that we happen to treat with usually. Indeed, formulas fairly true of averages may be quite untrue of the unit state. For this reason these laws may be quite incompatible with a final and finer reasoning. Nevertheless they may be useful as working rules. I believe that this criticism now applies to our rules and formulas.

S. Really, I hardly understand you there.

D. Here's a rough illustration. If you have ten piles of apples containing consecutively from one to ten apples in a pile you have a total of 55 apples in the ten piles. Now if you were always dealing with some condition involving tremendous numbers of piles of apples, you would be perfectly safe in assuming that each pile contained 5½ apples. Formulas based on the average of this irrational assumption would work closely enough in practices involving millions of piles, but the formula would prove more and more inaccurate as the number of piles lessened, and it would be utterly incorrect when referred to a single pile, for no one pile really does contain 5½ apples. And the philosophy is unsound, for, according to reason, the unit thing—here known as an apple—cannot be subdivided into halves and still be itself.

It seems to me that our formulas have been compiled to gauge certain composite experiences, and whereas they serve as fairly close approximations for our dealings with bodies involving innumerable unit-particles of matter, they are not true of the unit-reality, and when we try to reason out the unit-reality from them we encounter hopeless contradictions. Philosophy alone is capable of pointing out the error. Our gross perceptions cannot identify them.

S. That is an interesting thought.

D. I believe science has not derived exact formulas from

man's usual experiences with conditions as they prevail in the average on this earth, and I am fortified in this belief by the fact that the scientific conclusions are often unreasonable, and also because the formulas do not suit the smaller experience.

S. Of course no scientist has ever assumed that he knew anything of first causes. No one claims to know even the cause of motion. Science rather asserts that the cause of motion *is* a first cause, and can never be known.

D. Yet the cause of motion might well be a secondary cause, and quitė within the scope of human knowledge.

S. Yes, this, of course, is possible.

D. Now, I hope you will not feel abashed because the questions originated by my scepticism have revealed your ignorance. Doubtless, you know as much as most men of this day. No present-day physicist can fail to weaken before the right question. Nevertheless, as I say, the formulations of usual experiences do prove fairly accurate for the usual situation. Indeed, they show much ingenuity, and a quality of reasoned imagination that is encouraging. For certain conditions the generalized formulas closely interpret the truth, or else they would not be usable. And perhaps, with a very slight change in the original premise, we might alter them advantageously. We have assumed, let us say, that each pile contains 5½ apples. Suppose, through reason, we come to the more correct conclusion that in the smallest groups there are apples running from one to ten. With this slight correction, the appropriate formula would apply to the unit situation. With a slight change in hypothesis, our formulas may perhaps be made unassailable, and reason and experience will then support each other.

S. You encourage me greatly.

D. Now I am going to drop this subject for I want to tell you something that may interest you. It is written in the book of fate that I, René Descartes, am to be a noted philosopher. I, admitting an ignorance of

colossal proportions, but with my sceptical and analytical mind, shall found a system of philosophy that will be praised hereafter as the Cartesian system. I shall also found the mathematical science of Analytical Geometry. There appears to be scarcely any more valuable quality than scepticism. Accept nothing as true, my friend, until reason and experience agree concerning it. This, however, is not what I started to say, nor will scepticism by itself carry you far. Nor did I mean to boast when I told you of my future fame. In speaking of what was to be, I intimated that I could read the future somewhat. Grant me a little of the quality of prevision—whether I possess it or not—and I shall console your ignorance by reading ahead two or three centuries. I shall thus prove to you that this confusion of thought which you have confessed will still be existing on this earth even after these problems have been investigated two or three hundred more years by the brightest minds. Perhaps there will be too few sceptics and analysts in these next centuries, or perhaps these thinkers will accept too readily a premise which has been handed on to them from the past. Will you listen to my fairy tale?

S. Please exercise your imagination, or your faculty of prevision, whatever it may be, for it intrigues me.

D. Some 250 years hence a man will live in England who will have a mighty intellect, and an eager energy. He will devote himself to such puzzles as I have propounded. This man, Herbert Spencer, will attempt to prove that the human mind can never give answers to many of them.

S. Why will Spencer believe that?

D. He will assert that Matter, Force, Motion, Acceleration, Consciousness, are not secondary principles, below or equal to the human mind in degree. He will state, and attempt to prove, that they are primary principles superior to the human mind in the status of their being, and therefore unknowable. The causes of Gravi-

tation and Motion and the natures of them, he will say, can never be known. He will take one of the results of his everyday experience as a foundational premise upon which to prove this. If his premise is true, his reasoning will be true, but, otherwise, untrue.

S. What is this accepted truth that Spencer will use as his premise?

D. The doctrine that matter, being a first cause, can never be increased nor diminished in quantity. He will assert that motion is in the same changeless class. His premise, therefore, will be the doctrine of the Conservation of Matter and its Energy; and he will accept this as a universal and faultless truth—perhaps because it has come to him upheld by such great men as Sir Isaac Newton and Faraday.

S. Then, if this premise is unsound, Spencer's philosophy is unsound?

D. Yes. Spencer places the cause of these phenomena in a class quite beyond human ken, because it ranks infinitely higher than mind-power. We can never acquire knowledge of these principles, just as the boy who sweeps out the office can never learn what is in the contracts which the President locks up in his vault.

S. Will Spencer assert anything besides this rather peculiar statement that the mind knows that there are some things which it cannot know?

D. Yes, oddly enough, in the most difficult of all fields of knowledge, Spencer will insist that his mind-power does know something. He will attempt to explain and define Evolution, and he will found his theory on a doctrine which he believes is consistent with Conservation, but which is either inconsistent with it or is nothing at all. His theory of Evolution will be meaningless and mysterious, for he will say that Evolution is a process, first, of a coming-together with an increasing complexity, which concentration is followed by a separation with a decrease of complexity.

S. Excuse me for interrupting, but what force causes the concentration, and what power causes the concentra-

tion to cease? Then, after concentration has ceased, what causes the separating process to begin?

D. Your questions are pertinent. In fact, you have reached the great unreality of Spencer's theory. He explains Evolution as a mysterious oscillation in the universe. Now, we can understand how a pendulum can slow down, and stop, and then reverse its motion, because we have imagined a gravitational force in the environment that is master of the movement; but if the pendulum were the universe itself, if it represented all matter and its energy, and if, outside this universe as a whole there was no exterior power which could first cause concentration and then expansion, we should not have the slightest idea how the pendulum might begin moving, slow down, and stop. Some force must cause concentration; and some decrease in the force is indicated when the concentration is retarded. Any change in the average direction, or in the amount of motion, of a moving pendulum, when it is regarded as being the universe as a whole, is not only mysterious, but it is contrary, moment to moment, to the doctrine of the Conservation that Spencer believed in.

S. Of course, if a complete cycle of concentration and expansion is considered, the ending will be the same as the beginning, and nothing will have been done that remains done.

D. Yes, that is so. Conservation may apply to the complete cycle of Spencer's, but it will not apply to any of its parts. Except for a mysterious force not yet explained, like gravitation, we could not imagine why the pendulum of the clock in our room ever stops swinging to the right, or why it then reverses itself. If, however, we admit the presence of an unknown power independent of Conservation, a power which slows down and reverses motions, then, of course, we can say of a complete cycle forward and back, whether it be the cycle of the pendulum or of the earth's orbit, that nothing has been changed by the movement and nothing accomplished. Looking at the retraced path,

and without indentifying the power that created its reversed motions, we can claim—but of course erroneously—that Conservation applies to it. Conservation does define the average condition, perhaps, but never applies to any of its parts. This is Spencer's false idea of Evolution.

Conservation applies to the whole cycle of events, he believes, to the average of all the states, and he does not seem to consider whether it applies to any of the parts—to any of the curved or changed motions.

Every earthly wave-motion comes to an end because some exterior force stops it. Otherwise an ocean wave would continue rising till it struck the sky. And for every cycle to be explained there must be postulated some outside cause which in general controls the motion in the same fashion that gravitation controls the motion of the pendulum. We must suppose, indeed, that this unknown general Force first deliberately creates motions, and then creates their reversals. Must we assume, then, that these motions are futile, unaccomplishing, and purposeless, or must we perhaps admit that there has been an "absolute" accomplishment? Perhaps the cycle fails to repeat exactly? Even, however, if it should repeat exactly, it cannot be imagined in a monistic universe. Its reality disproves the principle of Conservation.

S. Is this unexplained oscillation of the pendulum of the universe, the great Spencer's theory of Evolution?

D. Yes. This will be his theory, and how meaningless! It only *seems* to cling to Conservation. It is predicated upon an unexplained activity which, one might say, is interpreted to exert itself busily to produce a totality of nothingness. Neither the mental nor the physical causes of the motions, nor the cause of the reversals, curvatures, and retardations in the total motion, is explained. These matters are hid so far away that few realize that the mystery has been buried rather than solved. Spencer himself does not seem to realize that his assumption of the changing speeds in

the pendulum of the universe connotes a lack of constancy in the amount of motion in the universe. He clings to Conservation through it all, yet his theory of movement denies his principle. As Charles Pierce said of him later "Spencer was only a half-evolutionist—only a semi-Spencerian."

S. Will no one criticize him for this inconsistency?

D. I see none in authority among those of his age who boldly takes issue with him.

S. Surely there will be someone who will perceive the paradox perverting the theory of Spencer, and who will attempt to develop an explanation of concentrating forces consistent with the probably incorrect Conservation doctrine that is held to.

D. Yes. There will be such a man. He will live in the beginning of the twentieth century. His name will be Albert Einstein, and he will develop a theory, which, however much it will seem to disregard the fact of Evolution, will nevertheless attempt to explain away the concentrating forces that appear to invalidate the Conservation doctrine.

S. How will he do this, pray?

D. I am afraid that you will think I am dreaming foolish dreams if I attempt to tell you what Einstein will think.

S. Oh no. Go ahead.

D. Well, very crudely stated, his theory will be this: He will attempt to explain away the mechanical cause of curved motions that seem to signify that energy is being used in a fashion contrary to Conservation. If concentrational energy is real, what is its source? The universal pendulum of the Spencerian theory must slow down and stop before it can start swinging in the opposite direction. Einstein will say that the pendulum of the universe as a whole never moves, that no "absolute" motion is possible in a universal sense. In this way he hopes to retain the Conservation doctrine —even from moment to moment. By denying "absolute" motion as a reality, and by asserting that there

is no natural tendency towards concentration in relatively moving objects, Einstein will escape the paradox of Spencer; for, as you perceive, Spencer claimed Conservation for his entire cycle but did not explain its absence during the changes. Nevertheless, Spencer denied that motion could ever be increased or diminished *in toto*. He may have thought that for some reason part of the universe could and would expand as fast as some other part of it concentrated.

S. But how can Einstein deny the "absolute" motions that do occur? I cannot understand what he means.

D. I was just coming to this. Einstein will explain away the seeming "absolute" forces, and will explain the failures of the universe either to dissipate endlessly or to concentrate solidly by saying that Time (that mysterious and unknown abstraction) is so changed by certain types of relative motions between different frames of reference that these apparent relative motions do not really exist as defined mechanically. Space-time is a constant. He will assert that the energies of moving bodies can be changed by the changes of their space-time. Asserting this, he can claim there is no "absolute" force tending either to general expansion or contraction. Space-Time he will assert also, is curved by the presence of mass at a distance. Hence, the general relative motion of an object through space-time is itself curved about the general center of mass. In this way relative motion is prevented from resulting either in straight-line dissipation or in utter concentration.

S. But, Monsieur Descartes, this theory of variable Time seems entirely inconceivable. It is consistent with the Conservation doctrine, in one sense, perhaps, but it appears to possess no other virtue,—and every lack of reasonableness!

D. I agree perfectly. But the Relativity theory will purport to explain events which are incompatible with the Newtonian principles. This will be believed to give it reasonableness.

S. Yes, but the mechanical formulas of Newton, as you say, were based on Conservation, and they cannot be expected to explain any change which represents a departure from Conservation. Thus, for example, they cannot explain Evolution. And you say that Einstein disregards Evolution entirely?

D. Yes. His theory fails to consider that any such "absolute" and significant change in one direction could possibly have developed mind-power from a world which was originally an incandescent gas. In his hypothesis the reality of his own mental power will be forgot.

S. Will Einstein attempt to identify the source of the power that changes Time? If this power is derived from relative motion, what does motion lose that can thus be given to Time?

D. Einstein will not touch on that subject.

S. Einstein seems to be putting Evolution into his formulas at the time that he is ignoring it. He accounts for significant phenomena by assuming an evolution in Time rather than in mechanical Conservation. If Time is not changeable, however, mechanical energy is itself variable, Evolution is a reality, and Conservation is not a reality.

D. My friend, you have reached my own conception. Einstein does not explain events. He has merely propounded a formula in terms of what he still regards as pure mechanism, and it is based upon inconceivabilities. He appears to be consistent with Conservation but his formula is inexplicable. Spencer is nearer the truth except that he incorrectly supposes that his pendulum of Change might some day be retarded and then reversed. Einstein is more consistent with Conservation than Spencer—or, at least, he believes he is. The moment, however, he alters the mechanical formulas to introduce Time as a variable, and Space-Time as a constant, his theory becomes inconsistent with Conservation, for variable Time cannot possibly be explained in terms of mechanics. His extraordinary theory will so puzzle people that they will not under-

stand exactly what he means, nor what his hypothesis signifies. Moreover, his hypothesis will have the virtue of getting so far away from the usual mechanical terms that his new formulas—changed according to a principle however inconceivable—will, in interpreting a certain particular class of phenomena, give results conforming closely with the facts.

S. Well, this is very interesting. The human mind certainly accomplishes progress in thought slowly. If your prevision is accurate, in the next two hundred years there will be no really sound explanation of fundamentals.

D. No. And the trouble seems to be that the philosophers and scientists, one after the other, begin with an incorrect mechanical premise. All argue from the basis of unproved mechanical determinism rather than from the facts of created motions and planned Evolution.

S. Are you going to try yourself to develop a philosophy and mechanics of life on the Evolutionary foundation?

D. No. But I am going to originate a line of thought. Besides being a thinker, I am, as I have said, a sceptic. I see very little truth in the theory that has been developed up to the present day; and, as you have observed, I do not think very much of some of the theories that will be advanced in the next few centuries. Certainly, everything fundamental is still shrouded in the unknown. We can chart a few experiences only. Yet, that is not quite true. There is one thing I *do* know, and on it I am going to build my philosophy.

S. What, pray, is this solid truth of yours?

D. I will tell it to you in these words: *Cogito, ergo sum.* I think, therefore I am.

S. Well, for the moment that sounds reasonable.

D. Yes, my friend, it sounds reasonable, as you say, and it is enough so to make me and it famous; yet, I am not so sure, after all, that there is very much sense in it.

CHAPTER III

THE RELATIONS BETWEEN MIND AND MATTER

If any man is able to convince me and show me that I do not think or act right, I will gladly change. For I seek the truth, by which no man was ever injured. But he is injured who abides in his error and ignorance.

MARCUS AURELIUS ANTONINUS.

RENÉ DESCARTES said *"Cogito, ergo sum"* ("I think, therefore I am"), and he believed that he had thus reduced fact to the irreducible minimum, and that this, his fact, *must* be admitted. Many assumptions, however, are hidden in this seemingly innocent, and yet controvertible statement.

Let us first consider the *I think*. To begin with, there must be an "I" capable of having thoughts and consciousness; other I's are also assumed having natures similar to mine; and, as *I am* is in the present tense, *I think* must also be in the present. One cannot think, however, unless he has something to think about. Our thoughts refer chiefly to sensations received (or that have been received) from an outside material world. For me to think, as human beings do think, I must presuppose the existence of such an exterior world about which I can think, or which, at least, has the associations that enable me to think. In one sense this outside world is the object of my thoughts, and from another view it (or, at least, its motions) appears to be the subject of them.

The indirect assumption is made, too, that this material world is different in quality and being from the mind-power that thinks of it. This matter-world has affected me or my body, the effect is past, and I *now* think of it. Even if my thoughts appear to be of the present, the event to which they now relate is past. The effect is past, at least, and my

thought, too, is past almost before I become conscious of it. Am I thinking in the present, then? If I do think in the present of an event that is past, there must be some means of connecting up the past happening with the present thought of it.

Even more must be assumed. The outside world of matter about which we think must somehow move and reach us—else our minds, devoted as they are chiefly to body-sensations, could not think about it. Not only must matter be different from mental quality, but there must be a means by which the effects of the blows of matter against our living bodies can reach, and find response, and have influence in, the realm of our thoughts. "But," some other "I" will now ask, "How is it possible that the mind does appreciate the blow of matter?" A difficult question this, yet all-important, and not to be put aside unsolved! My point is that just some such routine connecting mind and matter is taken for granted in the statement *I think,* but the nature of it is left unexplained.

Yet, what right have we to accept this mystery as an indubitable fact? Is the nature of any process certain so long as it remains mysterious? What quality, or character, or essence, or perfume, or slightest part of anything, does the mechanical blow lose that a new thought should arise from the effect of it? Can thoughts be created out of nothingness? Is there no material loss for each mental gain? Do we not unearth here a new mystery?

Or, might one have thoughts about a changeless character or condition? Surely not! The premise of Descartes, then, took much for granted—the existence of mind-power as something distinct from matter, a routine connecting the past mechanical event with the present mental consciousness of it, an exterior physical universe having relationships with the mind and acted upon by the mind, motions of matter-bodies within that universe,—motions that can end, and give effects to the mind in ending,—restraints of motions in general so that matter-bodies will not spread indefinitely out of contact one with another and with the living organism, a means of communication between substance in motion and

mind-power, and, finally, a Change in the material world (presupposing at the same time a Cause that has created this Change and the motions that remain within "dependable" bounds) that must surely be "absolute" [1] whether one gazes at a small part of the material universe, or whether one considers matter as a whole.

In accepting the seemingly simple *"Cogito, ergo sum"* as the foundations of his philosophy, Descartes seems to have taken for granted almost all the facts and relationships which have puzzled philosophical minds since the day when men began to think of abstruse subjects. A philosophy is scarcely required if one demands no explanation of that which Descartes accepted as if indisputable. Thomas Huxley truly remarked of this premise that—

> A little consideration will show this formula to be full of snares and verbal entanglements. In the first place, the "therefore" has no business there. The "I am" is assumed in the "I think," which is simply another way of saying "I am thinking." And, in the second place, "I think" is not one simple proposition, but three distinct assertions rolled into one. The first of these is, "something called I exist"; the second is "something called thought exists"; and the third is, "the thought is the result of the action of the I. [2]

While we may not admit with Huxley that the "thought is the result of the action of the 'I'," or that this is implied in the statement of Descartes, we recognize even more "verbal entanglements" than Huxley pointed out.

Jean Jacques Rousseau, who lived some 150 years after Descartes, was not a profound thinker. He did not possess the analytical and scientifically inquiring mind of Descartes. Nevertheless he sometimes achieved philosophic concepts, and he had the ability to express them convincingly. Like Spinoza, he loved Nature, and admired her so-called laws. He followed somewhat in the tracks of Descartes when he

[1] By "absolute" motion, I mean any motion in which the mechanical action and reaction are not equal—or any motion, if there may be such, in which the doctrine of the conservation of matter and its energy is breached.

[2] Thomas H. Huxley: *Descartes' Discourse on Method.*

thus states his Truth in the *Profession du Vicaire Savoyard* (in Emile): "I know that I exist, and have senses whereby I am affected." This is enough, Rousseau thought, for a philosophic foundation, providing that one may argue, as it seems logical to do, that the personality with "senses" is something different from that which "affects" those senses.

May it be asserted, then, that there is some difference between that which is in relationship with the mind-power of a man—which generates thoughts in him, so to speak—and that which thinks? We shall not now discuss this relationship, or the definitions distinguishing the attributes of mind from those of matter, but we shall assume for the moment that there is now, if not a duality of essence, at least a duality of quality-expressions. Without asserting that mind and matter are completely separable, we may surely say at least that they *do* now represent different quality-characteristics. An earth without a mind-power dwelling in it is different from an earth possessing one. An organism partly physical and partly mental or spiritual (and we use the word "spiritual" throughout almost as if synonymous with "mental"), whatever the mind may be, is different, in degree at least, from dead substance. Human beings do not behave exactly like stones. This much let us acknowledge. Later, when we have learned whether these assumptions—and the theories built thereon—are in harmony with, or antagonistic to, our general experiences, we may approve or condemn our premise.

Our first truth will be this—that conventional matter-quality is different from mind-quality. This truth, if sound truth, cuts the universe into halves.

What are these halves? Roughly these: Mental subjective consciousness, and the objective unconscious matter that is moved into relationships with the conscious mental; the organic[1] and the inorganic; the spiritual and the mechanical; the mental and the physical; the imponderable and the

[1] The word "organic" is used to designate that which is alive. An object imbued with a vital, living principle is organic. It is synonymous with "mental" if the latter be taken in its broadest sense, and if one will agree that a tree, for example—certainly organic—might be called mental, and that a rock had no mentality.

ponderable; the ability to *appreciate* mechanical situations and the ability to *have* mechanical situations; the particular living organism which to some extent creates motions different from those of the normal physical routine in general, and the particular physical object which has no ability to act independently, and which, in this sense, is dead. Surely this quality-duality is evident even though its limits are to be argued; and the fact that there is more than one character-quality makes possible the seething, hoping, suffering, rejoicing world. The reason for, and the nature of, the interacting parts may always be hidden and mysterious, yet, unless a dualism of some kind is admitted, nothing can ever be even in part explained.

Emerson put it strongly thus:

> On one side elemental order, sandstone and granite, rock-ledges, peat-bog, forest, sea and shore; and on the other part thought, the spirit which composes and decomposes nature,—here they are, side by side, god and devil, mind and matter, king and conspirator, belt and spasm, riding peacefully together in the eye and brain of every man. . . . The revelation of Thought takes man out of servitude into freedom. . . . Nature and Thought; two boys pushing each other on the curbstone of the pavement. Everything is pusher or pushed; and matter and mind are in perpetual tilt and balance, so.[1]

Here Emerson not only distinguished between mind and matter, but began to describe their separate qualities. And again:

> Every solid in the universe is ready to become fluid on the approach of the mind, and the power to flux it is the measure of mind. If the wall remain adamant, it accuses the want of thought. To a subtler force it will stream into new forms, expressive of the character of the mind.

Here, too, is a sentence of Emerson's which could follow only from a great thought: "Fate then is a name for facts not yet passed under the fire of thought; for causes which are unpenetrated."

[1] R. W. Emerson: *Fate.*

And Lord Balfour admirably writes:

> To me therefore it seems that in the present state of our knowledge or (if you prefer it) of our ignorance, we have no choice but to acquiesce provisionally in an unresolved dualism. Our experience has a double outlook. The first we may call material. It brings us face to face with such subjects as electricity, mass, motion, force, energy, and with such manifestations of energy as ethereal radiation. The second is spiritual. The first deals with objects which are measurable, calculable, capable (up to a point) of precise definition. The second deals with the immeasurable, the incalculable, the indefinable and (let me add) the all-important. The first touches the fundamentals of science; the second is intimately connected with religion. Yet different as they seem, both are real. They belong to the same universe; they influence each other; somewhere and somehow they must be in contact along a common frontier. . . . No man really supposes that he personally is nothing more than a changing group of electrical charges, so distributed that their relative motions enable or compel them in their collective capacity to will, to hope, to love, to think, perhaps to discuss themselves as a physical multiplicity, certainly to treat themselves as a mental unity. No creed of this kind can ever be extracted by valid reasoning from the sort of data which the physics either of the present or the future can possibly supply. [1]

Accepting the mental self as one thing, and the material environment as something different, and admitting then, as he must, that the quality of the universe is somehow divided, the philosopher is ready to begin the erection of his thought-structure—an edifice that seems to be constructed altogether by his mind-part. If one is sure that this dualism is real, then life holds scarcely a problem more worthy than that of considering the relations of the parts. The fact that there *are* two qualities (if but one essence) is, of course, the greatest of all mysteries. The nature of the Power and Purpose that created the essence of the universe is far beyond human comprehension; but the laws and relationships of the parts of the dualism, as it here now exists, are interesting and im-

[1] Introduction to *Science, Religion and Reality*, by Various Writers.

portant, and are also sufficiently perplexing to have engaged philosophic attention through many centuries without being completely charted and understood.

Philosophers have often tried to locate the "common frontier" along which mind and matter "must be in contact." At times, the physical world has been denied an existence separate from and independent of mind—just as the mental part of the dualism has often been regarded as something physically natured. Those who have asserted that there is no substance, have supported their ingenious theories with firm arguments. The materialist monists have, however, been equally clever and plausible. In the forefront of the "mentalists" was Bishop Berkeley. According to him, matter, so far as it can be known, is entirely a mental creation. In the practical sense, at least, substance does not exist except in the mind's view of it. The sensations received, he argued, do not originate exterior to mind, as they seem to do, but are fabrications of the mental creator dwelling within. Here, the mind is subject as well as object. The impressions from the supposed exterior world are not real in themselves, but are more like vibrations returning perhaps from an actual materialism outside to the mind of the person who caused them. Others took up and expanded this ingenious conception.

Now it is not my purpose to trace the development of philosophic thought through Berkeley, Locke, and Hume (the great Englishmen who so influenced Kant), or through the German school which followed Kant, with Fichte, Schelling, Hegel, and Schopenhauer. Nor shall I consider the more humanistic doctrines of later American philosophers. Whereas none of these great thinkers denied the reality of the spiritual or mental force in the universe, some, including Berkeley and Kant, questioned the probable reality of physical substance. They regarded matter as something un-mental in its essential character, and, therefore, as unknowable. They saw no way to prove the material presence through mental processes.

The concept that the matter-character is itself unreal, and that substance exists only as a mental creation, was not, however, advanced by Berkeley. He believed, as do most

men, that external matter *is* real and distinct. We shall return later to Kant's theory, based principally upon his conception of Time and Space. Here we must do more than discuss the premises of Descartes and Rousseau; we must reasonably define the world, if we can, and then, if we may, partly explain it. The former, indeed, is the larger problem, for the definitions become premises, and if the premises are sound they should lead straightforwardly to the explanations.

In a collection of lectures issued in book form, the late Josiah Royce, Professor of Philosophy at Harvard University, summarized in poetic words the mystical opinions about mind and matter of philosophers beginning with the seventeenth century, and also advanced his own synthesis of their various theories, attempting to show in what respect each was true. Although differing concepts came from each mind, all, he said, partook of truth. Professor Royce attempted to join together into a symmetrical whole this jumble of the curving thought-shapes of his predecessors. He thought that he perceived a curvature common to all. His synthesis, he felt, brought order out of confusion; disputed no one; but adjusted each idea to its harmonious place. The north and south sections of the earth are opposed, and are utterly different except when considered in respect to the entire world-sphere, yet, in this larger aspect, each sector represents an equally important part of the reality and truth of the earth's area. Their differences, properly synthesized, no longer oppose, but complement each other.

The synthesis of Professor Royce was idealistic, mental, somewhat dreamy—at least it lay in the rarefied air of the earlier metaphysical philosophers. His meanings and words are clear, but his thoughts seem to soar above the world. To him, the physical universe as a whole is a day-to-day creation of the mind as a whole. The existence (temporarily, at least) of a specific material quality—a character which would be real whether or not there existed a mentally endowed organism then conscious of it—seems to be denied; and the issues of Space and Time are dismissed as incomprehensible. Man still receives sensations from himself, as it were, or from a quality of which he is a part.

No one can scoff at the sympathetic concept of Professor Royce, or at the mind that created it; yet it is not altogether satisfactory. We wonder whether a synthesis heavier with material facts might not be obtained, one containing more dirt, and blood, and atoms, and movements of atoms that pound and smash—a theory that leans more on the physical aspects of experiences; one that draws more deeply from the earth.

May it be possible to reach more unemotionally, more through a philosophy based on general experience, a less vague picture wherein Space and Time are not dismissed, but are defined, and their significance explained? May not a real bond be established between matter and mind, a reasonable relationship in which Space and Time fill consistent parts, a dependence of one character upon the other as real as that which makes necessary the presence of substance possessing mass if the force of gravitation is to be real? May not the reality, the being, the cause of movements in both organic and inorganic realms be revealed in some understandable kinship of mind with matter? Substance and spirit may be derived from a single principle, to be sure, and yet each may now stand with a distinct and distinguishing quality, and also with a principle of association.

Agreeing only partly with Professor Royce, may we not affirm that the life of both matter and mind depends upon a process of change which affects both characters simultaneously, but differently—a process, which, by its active accomplishment, makes our lives of sensations real? Although matter finally may become mind, this theory indicates that for the duration of our earthly experience some of the material quality is always manifested characteristically. Only the movements of matter—and not the inner being of the material character—are indications of mental influence. The events of this partly physical, partly mental universe may be rationalized, perhaps, in terms of an Evolution which affects mind and matter simultaneously but in reverse directions, and which thus accounts for the significant change that seems to appear in each.

Is it possible to have a clearer understanding of what

is taking place? And may we support our conceptions of mind and matter, of space and time, of gravitation, of life and death, by treating at least partly with principles discovered by the aid of the perceived specific experience and also by means of a more general reasoning? The human mind is not yet such a perfect instrument that its theories unrelated to the physical actuality are to be regarded as more perfect than principles deduced from general or specific considerations of matter in its experienced associations with man. Every mental theory still requires some measure of materialistic confirmation. And because experience is gross and inexact, every mechanical law requires the justification of general reasoning. The philosophical premises, the definitions mentally chosen as reasonable, must dovetail with the physical facts to the extent that these facts are provable, or to the extent that the approximate accuracy of the experience carries its weight of proof. The premises need not correspond, perhaps, with supposed facts—namely with those which, in reference to the particular problem, are not exactly provable in a way that would, if proved, make them conclusive evidence for a contrary opinion.

If, therefore, in considering the relations of the material with the spiritual we seem to have intimations of a process connecting the life of matter with the mental activities of man, we should have more confidence in its truth, perhaps, than possesses us when we turn the last page of the beautiful metaphysics of Professor Royce.

Any idea relating significantly to man's life *must* harmonize to some necessary degree with physical principles. It must even help to explain them. Solid material influences greatly affect our earthly lives and the minds of the living are therefore concerned to an important degree with their material bodies, whereas these bodies, in turn, depend upon a world of moving particles from which they draw their sustenance and their possibilities of subjective sensations. A pure theory concerning life, a mental creation without reference to the sense-data obtained from matter in motion, or to the qualities which matter exhibits when moved by mind-power, may have suggestion, then, and inspiration, and

may even appear at times to have a reality which it does not possess, but earthly life is not confined to its subjectively mental side. As mental beings we are ever dependent upon bodies for our worldly relationships—for our lives. Substance is thus very real to us. We must obtain from matter our food and warmth; we must experience contacts with its weighty masses; and we must be fitted to endure their blows. A synthesis of life which attempts to be entirely spiritual and ideal, which regards matter as purely a mental creation; and which disregards the contemporaneous being and character-expressions of the material world, can do little but dazzle and inspire. And this is not enough—however much these purely mental interests and inspirations may be desired.

The present work attempts to build—on a dependable principle—one as firm and real as matter itself. If matter is impermanent, transient, and if it is not to endure, then the principle based upon its present characteristics may finally prove unreal; but, even so, material facts are now worthy of study.

To be consistent in its truth, as I view it, the principle of reality must embrace more than the present relationship of matter with mind. It must include the theory of Change—the principle of the movements of both matter and mind into new forms. It must be a theory which will account for both material and mental Evolution. It must be able to correlate a physical essence having movements indicating a disappearance of matter with a mental power which has free-will as to matter, which can make matter move, which is itself, as in man, perhaps being created by means of the universally caused movements of matter.

Explanations of the disappearing involutions in universal matter, and of the appearing evolutions in universal mind-power, and a description of the manner, result, and meaning of the processes of change in material and spiritual realms, constitute the highest aim of philosophy. No theory referring to a static, changeless state is valuable. Only "absolute" motions, and the "absolute" changes which such movements bring about, are significant. There are no laws for the

motionless and the dead. These characters have no right to laws, because, of themselves, they do not express.

Yet matter *is* moved, and these movements of bodies, because fairly regular, are subject to fairly dependable chartings. Matter and its motion together should interest us. Inert and motionless matter may interest us also, at least abstractly, for it is one part of the dualism of matter plus motion that makes phenomena possible. Motion, however, which is perhaps added to matter from the outside, is more to be studied and interpreted. Certainly the cause of motion cannot be discovered within the bounds of the solid corpuscle, or in the definition of unit-matter. That, then, which is outside of matter, which moves matter, has the greater significance for us. We must finally attribute to this Power the role of having created us by having created our physical relationships. To the extent that we value our earthly lives, therefore, we should ascribe importance to the Power creating motions. We may never be able to comprehend nor describe this Cause, and never understand the principle that has provided matter to be moved, but, however little of this we may know, we should at least realize, as Professor Royce wrote, that:

> If there is anything true in a philosophy of evolution, then there is something *more* than mere physical causation, mere mechanism in the world; for how can there be history in the world, no causal explanation, no appeal to mechanism as such, can ever directly express. In so far as you find mechanism only in the world, you find neither growth nor decay; you find no story at all.[1]

If by "mechanism" Professor Royce meant merely the material aspect of things,—namely, atoms with mass, and of themselves motionless, and blindly obeying a law of Conservation,—we agree with him completely. Whereas life signifies that there is both movement and change, substance when left to itself does not appreciably move, and no life (certainly no life of change) seems possible for it. Matter unaided, unmoved, at a distance, mere object with no subject

[1] Josiah Royce: *The Spirit of Modern Philosophy*, p. 290.

to make use of it, to move it, to bring it near, to make it expressive, to give it relationships with mind-power, contains no possibilities. In the stillness of unmoved matter there can be discovered no story; and such is our view of this inert substance that we believe unless some character quite different from it acted as its master—as active subject to its passive objectivity—that it would never start to move from a state of rest. The changing relative motions of matter presuppose an outside influence; but such an assumption does not indicate that the quality of matter while motionless is something identical with, and even created by, the mental quality. On the contrary, although the movements *may* be mentally caused, matter itself represents a distinct and separate principle.

A child may strike itself with a whip. The whip, if the child did not wield it, would lie quietly. Its motion, and its significance as a sensation-giver, are due to the organic will-power (let us claim this for the moment, at least) of the child. But is this all? The motion, the force of the whip, the shock, the sensation produced by it, may all be derived indirectly from the power of the child's will, but none of this means that the whip itself—the grouping of atoms with cohesion which the whip represents—is entirely a mental impression of the child.

Is the physical tool created itself by the mind; or does will-power merely cause the movement of the instrument? Does the will of the child, as something different from the matter-property, cause the being, the inertia, of the whip, or merely its change of position? Surely a distinction is to be drawn here. The human will-power perhaps makes the whip move, the child may perhaps create its own sensory experience; but does the child, or any other mental power exterior to matter, now create by its own will the character of matter itself; or the mechanical properties which we recognize as sense-data?

Perhaps the action of some universal mental power may cause the cohesion of the unit-particles composing the whip? Even if this be true, however, the particles of the whip, so long as they *are* particles of matter—dead themselves, but able when moved to deliver their energies to other particles

of matter—represent an unmental principle; or, we may at least say that so long as they *are* particles of matter, they do not and may not express mental qualities to a noticeable degree. They do not begin to move of themselves, and they display no appreciable power of volition, no will, and no purpose. Once the truth of this is granted, it must then be admitted that, so long as matter exhibits no appreciable attribute other than solid inertia, the universe must be regarded as dual. The cosmos must be composed of two distinct quality-characters; and the relations and meanings of this dualism supply the interesting and worth-while objects of the subjective thought. Yet, the quality-differences, after all, may relate, not to essence, but to arrangement—one arrangement being that which we call "material" and the other that which we know as "mental." This aspect of the theory will be developed later.

We return, then, to the premises of Rousseau and Descartes, admitting for the moment the two separate quality-characters of the world. During the life of matter, we agree, the cause of its restrained motions may be mental; the material involutions may be caused by a power more closely resembling mind than matter; the possibilities of sensations, even the relationships leading to the thoughts of man, may be due primarily to the blows of matter purposefully set in motion, and may thus be regarded as proceeding indirectly from a mental cause; nevertheless, the servant of the organic will, the tool of the mental power, matter itself, during the time that it so exists, is to be defined as a quality-character distinct from mind. Particles of matter may even be composed of unexpressive aggregations of mental energy; but mental power, when imbedded in matter, when arranged as substance, no longer has appreciably the power of the free agent, no longer expresses itself distinctively and independently. The physical thing must, then, be regarded as an arrangement different in quality from the mental essence—as different as the perpetual object is different from the perpetual subject, as the whip is different from the mind of the child, as inertia is different from free-will.

Some philosophers have been inclined to deny significant

Change to the physical universe. They have done this principally because they have accepted the doctrine that the totality of substance and its energy is changeless in quantity, and that all mass-motions balance perfectly. They believe that mechanical action and reaction forever equal and compensate each other. Not for one moment, they think, does the amount of mass-energy (active and potential) of the universe increase or diminish. No "absolute" energetic effect, they contend, is ever expressed in, or into, the universe as a whole. Substance and its energy, as a whole, has no life-cycle, no possibility of real change. Theoretically, matter has no potential ability—not even the power to have relationships with the mind of a man, or to reveal its external presence to him. We are not taking into consideration here the Einstein hypothesis that matter and its energy are interchangeable, nor are we considering the kind of change that would follow from the operations of the principle of entropy.[1] The conclusion that there is no significant change is inevitably reached by the pure mechanists who believe that all matter and energy is inherited in full measure, and who deny that motion is being created in the universe from moment to moment by an exterior mental Power, and that matter is being destroyed.

Those who deny the basic axiom of mechanism (Conservation), however, will also deny the principle of the increase of entropy, hence we need not consider this principle as accounting for Change. It seems to me that when I rub my hand with a rough cloth I have created a measure of heat which, except for the action of my will, would never have existed. If mental will can produce motion, it can nullify the principle of entropy in its entirety.

The strictly mechanical concepts are usually accepted, however, even though man lives in a world seething with

[1] According to the principle of the increase of entropy (the second law of thermodynamics), the active energy of the universe is constantly becoming less potential. It is tending more to a condition of balance and uniformity in which nothing can take place. Heat passes from the hotter body to the colder—never in the reverse direction. According to this principle the heat-relations of the universe are becoming more uniform. Thermal motions (and all energy-relations in adjacent fields of forces) are becoming more alike, so they can act on one another less and less.

oscillating motions, and even though his sensations continue from moment to moment as a result of these repeatedly delivered physical blows. To be consistent with such views we should, like Professor Royce, deny reality to the apparent and unceasing material Involution, which, so far as may be observed, has proceeded in one direction for all time. If we deny a changing existence to matter, however, we will be forced to use metaphysical arguments to destroy the contrary evidence of continuing physical change in this "show world."

Other philosophers have relied upon mental powers to explain not only the events but even the beings of all characters. The seeming material world is unreal of itself except as able somehow to "echo" mentally arranged phenomena. The sensations which the mind seems to receive from without are mere reflections from itself, like returning rays from a mirror held up and arranged for reflection in a certain fashion by the total mind-power of the universe. To the degree that each individual possesses mental brilliancy he receives the sensations of himself reflected back from the mirror of universal mind; and while these sensations are similar in character, and law, and harmonious with a mentally arranged principle, some reflections are weak and hazy, just as others, coming from stronger minds, are strong and clear, and with more reality. Because physical phenomena are, after all, merely disguised mental reflexes, order, law, and seeming intelligence, are to be found in the relations and activities of life.

Arguing in this fashion, one is fairly consistent with the Conservation theory. If matter (and its energy) is fixed as to quantity, and if substance has no volition, the physical world has no ability to express anything to a character different from it. Even if substance did exist separately, therefore, it could not, of itself, make its presence known to a mind external to it.

The conclusion does not follow, however, that because matter cannot express voluntary activity, it does not exist separately. The mystery is rather this: If substance as a whole does not move so as to deliver part of the effect of its

motion to mental rather than to mechanical realms, how can we *know* that it exists? Even if substance is real it is unknowable, we admit, unless it displays motion and unless *some of the effects of its motions reach mental fields.* Conversely, if substance is known to mind, it *does* display "absolute" motions. These motions *do* end in a material loss equivalent in some respect to the mental gain. Consequently, the concept of an "absolute" Evolution must be valid, and the Conservation theory must be regarded as invalid in so far as it refers only to matter and its energy.

This is a significant concept. Shall we take our stand, then, on the ground that substance does not exist except as a mental reflection; or shall we accept the view that it now exists independently, and that it becomes known to us because it is "charged" with an "absolute" and devolving motion which carries from material into mental realms? Before we make our choice between these alternatives let us examine the facts.

If organic mind, or will, is the sole ingredient of the universe, how can it change within itself? And yet we cannot deny the fact of mental Evolution. Yet, no earthly experiences, no mental conceptions, give us any inkling of how such change can "spontaneously" creep over any character from within; how any force, by its own internal energy, can add to its own total power. To escape from our dilemma we may dream hazily of some sort of *ever-active "élan vital,"* or vital impulse, but, even then, significant Change of this sort is not understood. In throwing this rigid and unit concept of the universe into purely mental realms, we do not improve our understanding but merely add to our confusion. Nor is the purely materialistic view more satisfactory. Nor the view that all is mechanical energy.

To believe in significant Change, we must admit the presence of two elements. Or, two arrangements of one element may be the better statement. Change may occur by the interaction of two now separately existing principles, and if the Change occurs solely by means of motion, the separating distinction *must refer to arrangement,* and not to essence. One arrangement must be negative and the other positive.

One must suffer subtractions from itself and the other must receive additions. No other sort of persistent change is conceivable. For this "absolute" change to continue for ever in one direction, moreover, one arrangement *must have control of the other.* There is no purely mechanical explanation of Change—as the principle of entropy (the last ditch of the pure mechanist attempting to account for Change) might seem to indicate to some persons. To one arrangement the primal Creative Force behind all things must give a power-preference, and this preference must be displayed in its ability to exercise mastery. The mind displays its mastery over the material arrangement by moving it into new arrangements. This we prefer to believe.

If the universe were entirely mental (or entirely physical) there could be no increase or decrease in its power-expression. Yet we who deny a perfected unity in the universe of to-day, must found our beliefs in conformity with this denial. A theory of significant Change, we insist, presupposes a relationship between two characters both of which are now fundamentally important and *each of which is changing.* Not only this, but *the change in one must balance and compensate the change in the other.* The only escape from this belief is found in the idea of a continuous manufacture of something out of nothingness; and this possibility is acceptable to no one. Aristotle, in his *Metaphysics,* thus proclaimed this truth: "That nothing comes to be out of that which is not, but everything out of that which is, is a doctrine common to nearly all the nature philosophers."

If we admit mental life, if we accept any part of the premise of Descartes, if we admit life at all, we must agree not only that it has significance, but that it is the product of some "absolute" movement standing for accomplishment, for planned change, for both increases and decreases of specified powers in specific realms—that is, for both Involution and Evolution. If Change is admitted, however, in one part of the whole, it must be agreed that there is another part (even though invisible and intangible) in which "absolute" motion is expressed to an equal degree *but in an opposite direction.* Otherwise, as Professor Royce thought, life would

be impossible. Changeless being is not sensation—it is death. For life, something must either be evolving or involving; and, if it is doing either its additions must be related to some other existing reality composed primarily of its own essence, and from which, it, by its own power, may draw.

Because there is life, with its mental sensations, growths, evolutions, there is no escape from the idea of a final compensation that is reached through the changes in a dualism. These must be a plus and a minus, a positive and a negative, happening. *And the admitted fact of a mental life and evolution should make us expect an involution of matter* for matter seems to be the only part of the universe existing contemporaneously that might shrink in the proportion that mental power expands. Matter, the passive principle, must be present, must be changed, and must itself consist basically of a mental arrangement, therefore, if the evolving growth in mental power is to be as real as it seems.

We have reached the conclusion insisted on by reason that we should not deny the physical Involution that our eyes behold, but rather that we should have prophesied it; and, now that we have realized this reasonableness, we should accept it as proof that organic power is evolving and progressing towards an ultimate perfection. Through organic increasing we may prove inorganic decreasing, and through inorganic decreasing we may prove organic increasing. We have the right to use either phenomenon as proof of the other—not only as proof of the alteration in the other realm, but as positive evidence of the reality of the other's character, and even for a comprehension and description of its kind, and for an *explanation* of what occurs.

Aware of ourselves as living organisms with sensations, volitions, and consciousness, we should use our mental appreciation *of* ourselves (and of the processes and changes taking place within our bodies and species) to prove the physical presence, the nature of its motion, and even the characteristics of the material world. Within ourselves, in our minds, we should have the power to proclaim, describe, and explain the negative of the mental, called substance. We should thus identify the realities of that matter which is purposefully

being moved, and which is pounding us into life-relationships. The organic power of earthly beings must also be obtained from the motions of matter-bodies, and, from them, too, must come the mental or subjective aspect of the sensation relationship, and the mental changes as well.

Matter must, in one sense, be the opposite or negative of mind—but not its opposite in basic essence, for, if one principle is to be re-arranged into the other, there must be *a sameness of inner being.* The opposition, therefore, must refer to condition, and it, in turn, must depend upon arrangement. The matter-quality is as permanent and dependable as matter is permanent and dependable (in its arrangement), and no more so. But, because matter is composed of mental essence—such is our hypothesis—substance, as it delivers momentum, and leaves the effects of its blows even in mental realms (becoming mind-power, as it were), may be appreciated and measured mentally. Because substance sheds some of itself to reach to, and to become, mental power, and also because its inertia can serve as the object of the mental activities and be made to move according to the mental will, it is subject to the recognition and understanding of the mental power. This perception is enough (in this seething world) to make us as conscious as needs be of the balanced and symmetrical types of matter surrounding us. The mind in its relations with the physical, at least knows that which emanates from substance and which reaches mind with its effect and its evolution. And it knows matter as the object of its own will. The human mind, however, directly senses (as we shall discover) only certain of the mechanical impulses—namely those which are rhythmic and regular.

A mind affected by matter soon becomes acquainted with the characteristic messengers from certain types of matter-bodies. From the mind's day-by-day association with these messengers it has become aware of the typical characters of the different elements. Direct mental appreciation goes no farther. More important even than this recognition of typical composite energy-relations from the energy-effects of its repeated characteristic messengers, however, is the mental deduction drawn from the fact of this recognition. We

deduce, indeed, that there *is* a devolving physical universe. We conclude that a consistent disappearance of matter is in process—a dissolution of the material by rearrangement, and a process sufficiently basic to dispose finally of the physical quality.

We shall not in this chapter attempt to penetrate deeply into this relationship of matter and mind, but we do wish to emphasize the fact that these quality-oppositions of mind and matter are not paradoxes, but rather they are significant facts. They are the potential sources of the changes which *must* occur if there is to be a life-experience. Except for the presence of these opposites which can, and finally do, meet in a rearrangement of one of them, there could be no earthly life. Life is virtually the series of events recording the effect of the rearrangement of matter into mind. As matter disappears, and mind appears, new conditions of opposition (and therefore new qualities) are revealed in the relationships of the changing parts of the dualism. Nor does the life-experience repeat itself.

Matter is as much needed to play the opposite of mind as heat is necessary for cold, as high is necessary for low, as evil for good, as masculine for feminine, as fast for slow, as narrow for broad, as mechanism for free-will. All the other seeming oppositions, contradictions, and extremes of life (usually regarded as exactly and forever equal in opposition, but really not exactly so) become reasonable when one regards life as necessarily a part of a tremendous cycle of significant Change in which the material arrangement is being evolved into the mental—the inorganic into the organic. Before there can be this transformation, this change of life, unlike qualities of conditions *must* exist. Life and its evolution cannot develop a condition of coldness unless there is somewhere heat; it cannot produce beauty unless there is somewhere a condition regardable as ugliness; it cannot exhibit the movements of a growing free-will unless there is something which lacks conscious volition; it cannot display mental experiences with the physical unless there is somewhere a devolving substance. The degree of opposition may

be altering, but the presence of opposites is essential if change is to occur.

In the sublime cycle in which matter is being transformed into mind, all shades and degrees of the characteristic oppositions of qualities are revealed. The change, however, takes place slowly—so slowly through the ages that only the fact of opposition is seen, and not the gradual reductions from the one character, and the additions to the other. We are inclined to overlook this creeping persistent transmutation when we view such abstractions as goodness and justice, or such attributes as form, inertia, Space and Time, and the like. We incline to deny the gradual disappearance of matter, the slow changing of mechanical length into a spaceless point, the dissolving of material extension into non-extension, the transformation of real (or physical) space into non-space: and we even disregard the more obvious disappearance and transformation of heat into no-heat. We deny what a truer philosophy might prove to be essential. Who was it that used the pregnant phrase "the inevitability of gradualness," which describes so well the unperceived but inevitable Involution of the physical universe?

The premise of Descartes, then, is not enough for us: nor has Professor William James been sufficiently broad in declaring that:—

> There is but one indefectibly certain truth, and that is the truth that pyrrhonistic scepticism itself leaves standing—the truth that the present phenomenon of consciousness exists. That, however, is the bare starting-point of knowledge, the mere admission of the stuff to be philosophical about. The various philosophies are but so many attempts at expressing what the stuff really is.[1]

Those philosophers who accept organic consciousness as the one indubitable truth, and who therefore regard the mind itself as steadfast and changeless, and who have therefore half-heartedly denied the existence of matter, have failed to realize that the fact and growth of human consciousness, and the laws of opposites which life and change signify,

[1] William James: *On Philosophy*, pp. 110–11.

not only prove the continued being of matter, but even tell, perhaps, what its very nature and essence must be. If mind is expanding and matter shrinking; if mind-power grows out of matter-power; if activity and will-power come out of inertness and lack of volition, what, then, is the inner being of this opposite from which mind-power takes its essence and derives its growth?

Here, in this wave-cycle, in this undulation that expresses the rising from the depths of matter to the heights of mind, we are conscious (in-so-far as we represent mind-power) of one-half the swelling wave. Can reason now reveal to us the other half? Can we describe accurately the concealed left-hand path of the oscillating pendulum? This seems to be the real problem of the philosopher. He must learn more than he can possibly learn directly from his sensational experiences with composites. Reason must reveal to him the nature of the very unit event. Reason, and not the specific experiences, must supply him with his basic definitions, his premises.

The organic is constantly absorbing additions to its own quality from the inorganic. In this transformation the significance of existence may perhaps be discovered. Thus there is invisible, seething steam which in its very nature is hot; and there is visible and sluggish water which is relatively cold. Quite different from steam, we note, is this water. Here, we say, is an example of the positive and its negative. Yet, is there an opposition after all? Is not the water composed of that which gives steam its quality? Must anything be added, indeed, but a little of the steam's heat for these opposites to grow misty and vanish: for all these contradictory qualities to disappear into unreality: for the lifeless water to be transformed into active steam, forever hot of its own nature we may assume, and forever different from water, and without paradoxes within its being? Is this analogy of water and steam, when greatly extended, a fair analogy of the relationship of matter with mind?

Professor Royce has said:—"Thought produces thought, just as body moves body, while on the other hand it is inconceivable that mind should act on body, or body explain mind. And so these two orders, mental and corporeal, are precisely

parallel. For neither belongs to, or is part of, or is explained by, the other." [1]

This statement differs from the description just given of the relation of matter to mind. Instead of being parallel qualities, they seem to be opposites to the uttermost extent that opposition is possible. This opposition appears to be the parents of a large family of contradictory children. One quality relates to the living, the other to the dead; one is visible, the other invisible; one has temperature, the other none; one only has dead inertia and occupies extension, the other only has live activity and consciousness. One is devolving, the other is evolving. By noting the transformation and quality of the one, and by the use of reasoning power, the all of the other may perhaps be known.

Matter is composed of mind-essence, perhaps, but it is an arrangement without the degree of life and activity of that which is called mind. The material is the negative or physical and objective aspect of the mentally positive and subjective power. There is a quality-opposition here which is as real and valid as the oppositions between motion and quietude, between the dead and the living. The less matter in our universe the less deadness, quietude, mass, extension and other purely physical qualities in it. Mind, by giving motion to matter gives it change. Substance, bit by bit, is changed into the mental, and as this transformation proceeds all the oppositions are fated to disappear—just as the material water, when heat is added, becomes ethereal, invisible steam.

Many a thinker has thought it necessary to deny physical Involution. The reasoning man with creative imagination, believing that the scientist is correct in his facts so far as he claims them, has conceived a philosophy which he hopes to be able to correspond with accepted scientific knowledge —and particularly to correspond with the doctrine of Conservation. He has tried to be practical, unfortunately, when, instead, he should have created his independent thought-structure. Instead of acknowledging an "absolute" change of the elements of mechanics as a reasonable necessity, and instead of obtaining a theory that should correspond with this

[1] Josiah Royce: *The Spirit of Modern Philosophy*, pp. 63–64.

reasonable view, many philosophers have explained away facts by hiding them mistily in dream clouds. As an example of this viewpoint we quote again from Professor Royce:

> The result, so far, is that the world of the endlessly consolidating matter can't be the ultimately real world, but must be only a seeming world whose anomalous character, is due to our private and human point of view. Seen as we see it, the empirical truth about matter and energy must be only the show of a deeper truth. This apparent law of the endless consolidation of the universe must be only a fragmentary aspect. These stars and "intertwined spirals" and "convoluted windings" of stars, these hypothetical molecules that have been forever falling nearer and nearer together, this process that has been forever taking one direction without reaching as yet its goal,—all these things must belong to the show of reality. The substance, the soul of it all, must lie behind. The real world process cannot thus be essentially a paradox, essentially incomplete, fundamentally absurd. It must have at least as much unity and self-consistency as a "cyclical" physical process. When we see it as we do, in this ragged and unintelligible shape, that must be because, in our experience, we are but playing with the "pebbles on the beach." The "ocean of ultimate reality and truth" must lie beyond. [1]

This is the view of one who states that the Involution of matter is inconceivable because he can form no mental image of its beginning or end. All that has taken place and all that is taking place must be regarded as unreal and untrue—as merely the view of one who somehow sees only a part of the all-comprehensive and ultimate. There must be somewhere a deeper truth in which there is to be discovered no permanent change in the physical world. We must arrange to agree with the Conservation axiom of the physicists. One who has this faith should sympathize especially with Professor Einstein, who, in face of the contrary facts everywhere confronting us, says that there is no "absolute" motion in matter, no Involution of matter and its energy (together), no unbalanced change consistently in one direction—except,

[1] *Ibid.*, pp. 334–5.

perhaps, the change that corresponds with the principle of the increase of entropy.

When radium decomposes and devolves "spontaneously" before our eyes, never, so far as we know, to be reassembled later, we must overlook the fact, or, at least, we must explain it by saying that somehow it is not broadly real. The slow alterations in the celestial bodies must be regarded, not as an indication of significant change, but merely as an idea of ours about a certain aspect of a material whole that somehow, in some way, when conceived in a deeper truth, is always balanced and changeless—perhaps, again, nothing more than the change satisfying the principle of the increase of entropy. To accord with this creed, even the force of gravitation must be explained away. Orbits must be regarded as meaningless time-cycles repeating themselves spontaneously and almost perfectly.

Professor Einstein uses conceptions in some respects as imaginative and intangible as those of the metaphysicians. His theory lies deep in a mist where reason does not attempt to penetrate. He contends that Time is so changed by relative motion between different frames of reference that certain apparent energy-changes are compensated by the changes in Time, and, therefore, that relative phenomena, as otherwise to be expected, do not take place. Time is the veritable divinity of some persons. Because variations of Time can be introduced to take the place of God as an active and creative presence in the interpretations (by formulas) of some of the phenomena of the physical universe, its introduction into physics appears to be all the more satisfactory. Mustn't mechanics be explained entirely in terms of strictly mechanical principles? What mechanist will deliberately introduce a creative Mental Cause into mechanics? Isn't almost any other explanation more suitable? If mental power *were* introduced as a Creative Cause, the science would no longer be scientific—for it would no longer be amenable to formulation. Would it not become completely haphazard and unpredictable? And doesn't the very fact that physics is orderly and predictable prove that the principle of action

equalling reaction does apply to it, and that no independent mental freedom and power has sway?

Given the alternative, the modern theorists seem to prefer to deny Evolution of mental power—the power that they use in developing their theories. Upon the premise of mechanical Conservation in a monistic universe, mental Evolution cannot be conceded as something distinct from matter-changes. If Conservation is true, if the universe contains only mechanics, if there is no active Creative Cause, Evolution must be regarded as a myth—or else as a continuous and inexplicable creation of something out of nothing!

The mechanists may deny the perpetual Involution of matter if they will, and may base their denial upon any imaginative hypothesis, but how can they deny the Evolution of mind? We wish to know how they can admit organic change and at the same time affirm that the matter and energy of the universe is changeless, and that the entirely physical quality-change in the average condition comes solely from the fact that the unbalanced energy-expressions of matter-bodies in motion are being equalized—namely, that the hot things are becoming cooler in an irreversible process, and that energy-potential of the possible activities is becoming less? Surely a more powerful mental character cannot develop from the chance-rearrangements of matter in general, for such a rearrangement, if altogether in one direction, would itself signify an "absolute", and not a chance-occurrence-change. Evolutionary mental change is something different from the running down of the clock of the energy-potential of the universe, and cannot thus be interpreted. Yet, all other possibilities appear to be denied by the stricter scientists. We, therefore, deny their science. The evolutionary rearrangement and growth, it seems to us, indicate the accomplishment and presence of an "absolute" power—an influence exterior to and different from anything that might be displayed by the mechanical world of matter.

The mental power is surely real! It *does* form part of the universe! Who, then, can explain it away? And who can assert that it is indeed changeless? Who can deny its separate and non-material reality and power? Who can fail to

admit that the universe is dualistic, and that matter is undergoing an absolute evolution in which the physical reality is being reduced?

We have outlined some of the difficulties of those who accept the view of a Royce or of an Einstein. Both mental and physical facts must be denied, explained away, or forgot. Professor Einstein does not discuss mental realms or powers. He seems content to propose an adjustment of a formula, which change seems to fit in with the known deviations from strictly Newtonian mechanics in certain inter-world relationships. That which is thus obtained, is regarded as a new kind, but a still strictly pure kind, of mechanics. His theory —if one can regard the unexplained introduction of variable Time into physics as a theory—relates only to certain classes of mechanical phenomena. In this adjustment of formula Einstein has virtually ascribed inconceivable powers to abstractions which, according to our view, can take no such part in mechanics. The changes in Time and Space which he stipulates must, we believe, be the disguised accomplishments of a spiritual Power. They do not conform to the principle of mechanical determinism.

The Einstein hypothesis, if sound, would even make a really significant Evolution impossible. In one sense it denies that the mental might exercise power over the physical. It thus virtually denies the mind the ability to develop such a theory of mechanics. According to his interpretations of the physical phenomena, if there is a dualism its parts must somehow be completely distinct and separate. He leaves no place for spiritual accomplishments in mechanical realms.

I can more easily sympathize with the view of Professor Royce. If I regard the material world as a mental creation, and substance as nothing of itself, then physical changes are not physically, but mentally, caused. The changes then follow mentally-arranged laws. The mental change that is postulated is not explained, it is merely accepted.

Yet I do not regard matter as a *moment to moment* creation of mind. If all the *active* mind in the universe were suddenly transported to other realms, this physical principle —which is mind in a passive inert arrangement—would still

exist. Substance may be regarded as real in itself only if we may ascribe reality to an essence which, if left alone, would be dead and inert and motionless. Its ability to make certain aspects of its reality known to our minds comes from two important principles; first, mental power can and does cause matter to move; secondly, by means of these created movements a Change occurs in which (so to speak) matter is decomposed, and in which the essential material quality, mental power itself, is released from within the inert structure of the matter-body. Thus the material world experiences Involution. In this concept the world-process emerges from the paradoxical form which Professor Royce rightly contends cannot be the final reality; and existence takes on not "as much unity and self-consistency as a 'cyclical' physical process," but a greater unity and self-consistency. Not a cycle, but a spiral ending in time (but having meanwhile the self-consistency and unity and reasonableness of a process of Change purposefully created and purposefully carried out), lasts from the moment of the appearance of physical matter to the day of its complete disappearance. This process involving the transformation of matter into mind gives life reality and significance.

The argument runs thus: I am alive, and I am conscious of being alive, and of myself as a conscious thinking being. My life-experience indicates that I am changing from moment to moment, from day to day, for, without change, life would be impossible. Without change there would be nothing to think about, nothing to be conscious of, nothing to be alive for. I am born, I increase in mind and body during my youth, and in old age I shrivel and die. So far as I can perceive I do not remain the same for a moment. My life is change personified; so I can earnestly believe in the principle of Change. I can believe also in the century-to-century change in the human species. I believe in a general Evolution that goes back further than man can read the history of the rocks. Scientists have recognized and admitted that there has been a growth of mental powers. Experience, observation, and reason confirm this view. Furthermore, there has been a change in the average physical environment, an evident altera-

tion of some of the elements not in accord with the principle of entropy.

Some persons have vainly attempted to forget the steady physical changes. Others have tried to explain them away because they were not understood, and because they did not fit in with the accepted doctrine of Conservation of matter and its energy—a doctrine based on the appearance of a condition of energy-stability in our daily experiences. Nor do the principles of Conservation and gravitation (that is, the "attractive" power inducing the concentration of matter by means of motion) appear to harmonize. Perhaps they may be harmonized to a critical reason only if one is willing to accept the fact of Evolution both in matter and mind. Otherwise it may be necessary to admit the inconceivable doctrine that Time is changed by relative motion and that, on this account, space-time only is a constant (although space-time itself may be curved by the presence of matter at a distance), and that curved space-time, and not gravitational energy, causes the repeating cycles of the stars and planets. An analysis of the significance of Time, however, may dispose of this inconceivable hypothesis.

Change would be impossible without "absolute" motion, for not even a wave-oscillation can be originated without the use of exterior energy. And after an undulation has been started by a power of movement exterior to it, the force of the wave cannot be used to affect or alter anything outside itself, cannot make itself known to its environment, cannot express any reality unless it surrenders part of its inherited energy of motion. If the undulation is to be recognized, if an effect is to be delivered, the wave must lose part of its energy, and thus be changed "absolutely." To be real to our minds the wave-principle must first be moved into contact with the other matter by an "absolute" power, and it then must itself be changed by the surrender of some of its inherited power. It must then become less significant as a wave. A swinging pendulum must lessen its average swinging if it is to do work. Nor will this surrender of energy (for the time being an inherited energy), a surrender due to change, ever be reversed "spontaneously." Nor do the changing elements reconstitute

themselves. And, in some cases, changes are never reversed. Thus, radium never seems to be recomposed. An "absolute" force exterior to it—perhaps a change in the universal equilibrium of energy, as later referred to—must have expressed itself in some new fashion before the radium begins to erupt. This product of an "absolute" Evolution does not appear to be re-created. This change is not comparable to the running down of the clock of the activity in the universe.

Motion is perhaps the most significant character in the creation of life-sensations. All matter unceasingly moves. The cause of change is motion, and the cause primary to Evolution, therefore, must be that which creates motion. Yet we repeat, if motion is the cause preceding change, the evolutionary result *must be obtained from a rearrangement.* Nothing else is conceivable.

Now, obviously, the normal mechanical average condition of a material arrangement can be changed only through the influence of an external power, and the change indicates and measures the receipt of this additional power—and even describes it. The change, then, must be expressed finally in terms of the principle which causes the alteration. Thus, if a mind power creates change, the result of the process must finally be appreciated by, and even appear as a result in, mental realms. Other results are incidental. The quality characteristics which change with structural alterations are superficial and conditional character-expressions. They merely happen to be appropriate to the new situation. Thus, if heat is added to water and it becomes steam, the invisibility of steam is the incidental (or we might say "natural") quality of the gas, but invisibility is not necessarily an attribute of heat. On the contrary, according to my hypothesis, the heat-quality and the quality either of visibility or invisibility are important merely because they are those properties which, through their abilities to give us positive or negative sensational impressions, permit us to obtain a certain type of knowledge of the energy-natures of the matter-structures.

Matter, itself, is either entirely a materialistic arrangement, expressing characteristic matter-qualities, or else, intrinsically, it is not matter. Motion is not material. It is

added to matter from the outside. When the essence composing matter appears in its mental arrangement, it displays none of the physical properties of extension, form, mass, hardness, color, taste. When transformed the inert bit is no longer matter, but is typically mental, typically the other part of the dualism. The quality-separation between the mental and material arrangement is a fairly wide and fairly permanent chasm. Not altogether permanent, however, as we perceive. When motion is added to matter it permits the parts of the atoms to express their inertness in characterisic series and frequencies, and with corresponding abilities to give the relationships with mind known as "sensations," but, when the motion is such that the arrangement which displays inertia is decomposed, no physical qualities linger within the spiritual arrangement as then revealed.

The effect of the motions of matter-bodies may be classified in two principal ways. The first ends in the mechanical rearrangements of structures—changes which are comparatively unimportant. Many of these movements may even take place in almost complete accord with conventional mechanics. In many such cases physical action seems to be followed by approximately equal physical reaction. The more important motion ends in the complete disruption of the smallest or unit bit of matter. After receiving the latter "charge of motion" the bit of matter no longer exists with its former matter-quality of inertness. The motion ending in such a change is the important event. It alone is "absolute" in respect of the matter-quality, for, in it, the matter-quality disappears. From this significant event flows the Evolution of matter into mind. This most vital change gives us life.

In saying "I think, therefore I am," Descartes, a life-form with thinking powers associated with a physical body, affirmed the existence of two different principles. The first, space-occupying inertia, is the primary characteristic of the material world, and every delivery to our mind of colour, sound, taste, smell, and touch—that is to say, every unusual series of energy-expressions resulting in a mental sensation —comes to us as a series of impulses received from inert matter-particles that have been mentally moved. Even

gravitation, we believe, must be interpreted as the effect of the blows of inert matter for, otherwise, it will fall outside of the physical definition. Mentality, on the other hand, has no measurable mass, and, therefore, no momentum. It has none of the typical materialistic qualities. Its one relation with matter that requires the attention of the physicist appears to rest in its ability to make matter move.

In Evolution, the unit-particle of inert substance, we believe, is rent asunder, and the essence composing it is released from solid rigidity into an independent freedom of action. This new state is mind-power; and it expresses a new principle. This hypothesis will be the subject of our investigation. Its validity must be tested by reference to "facts," but before the "facts" are accepted they, too, must be tested by reason. The theory, if it be sound, should help to illumine those relationships which are now deemed unknowable and mystifying. It should reveal new and sounder "facts."

It is natural that during the transformation of matter into mind, the living organism, which is in touch with both physical and mental conditions, and which is only faintly endowed with conscious mental powers, should realize some of the seeming paradoxes of its position as a half-and-half character, and should be puzzled by them. Even Evolution is not usually recognized, or its reality interpreted, for its flow is almost imperceptible during any one generation. Nevertheless, the mental evolution, even that in man, becomes evident when measured in terms of the life of our species. During the ages, in a significant sense, the physical world devolves, and the mental characters steadily evolve. A mental understanding of the nature of this Evolution, and of its significance and its accomplishments, may permit man better to realize his place in the scheme of things.

So long as the physical universe exists, so long as its rigid parts are able to give us mental sensations, the dualistic quality of our experiences will persist. The experience will be a blend, partly physical partly mental, partly mentally subjective partly due to the objective presence of moving matter-bodies. The physical is the opposite of the mental both in

condition and in manifestation, hence our life-experiences are composed of these opposed influences. As the ages slip by, however, and as Evolution proceeds, the wave-crests of substance will subside; the wave-hollows of the mental will become less profound; the high and the low will approach; the undulations will move through shorter arcs; and the totality of oppositions will gradually reduce.

This forward movement is our greatest reality. In this fundamental tendency to change there is no opposition, but only unalterable, uninfluenced, all-embracing, and transcendent Truth—a very unity in Truth, the verity of life itself—a dependable principle which will hold good until the end of the Evolution of matter is reached, and until a still larger plan has unfolded. The influences of the moment—conditions which appear as stationary fillers between evolutionary changes—contain vivid contrasts, we admit, but there is no inconsistency or opposition in the activity, in the motion, or in the direction of this fundamental change. And this steady progress towards an end not only makes us alive in the *half mental half material* sense in which we are, but also makes the oppositions lessen,—at least in quantity, if not in degree,—finally to disappear.

According to this theory, the instantaneous view will disclose matter and mind existing in a definite relation and with a definite opposition. The opposition is revealed both qualitatively and quantitatively. At a later moment, however, the opposition will be discovered in a new proportion. At least the *quantity* of matter will change as the repeated motions have their "absolute" effect.

The driving force behind the general motions of matter seems to be a power similar in some respects to that possessed by man. The mental powers, weak in us, and strong in the supreme Cause, apparently do not remain inactive in the presence of inert matter. They constantly express their will and power in accomplishing something with the physical. They give it motions. Thus, mind-power virtually creates the sensations which make for life. In asserting that a mental power of universal sway is the force which, always present, always active, drives matter into new positions, and

which causes its repeated oscillations, I am in accord with the view of Professor Royce that the sensations of life have a mental parentage; yet, by a difference in theory, I remain consistent with the view that matter is a character distinct and separate from mental power. I do not believe that substance is a moment-to-moment creation of the universal mind. Not the physical essence of the universe, but its motions, and therefore, its sensation-giving powers, are repeated creations of this mental power. In important respects my conception differs from that of Professor Royce. My hypothesis, when carried on, seems to me to explain and clarify phenomena instead of leaving them unreal, mysterious, and inconceivable.

In this chapter one has a glimpse of the thoughts which, in later pages, I shall attempt to prove by more specific considerations. I do not agree with the physicists that all the motions of the masses of the universe (the matter and its energy, active and potential) are inherited unaltered from past ages. It seems incredible that the motions of bodies which are constantly in close contact, and colliding, should not long ago have been cancelled even if the matter itself remained in full quantity. I do not believe that matter and its energy are the same. I cannot conceive of mechanical energy being self-existent, or as being deliverable without the use of matter. I assert, that which I attempt to prove, that if we imagine a head-on collision at equal velocities of two rigidly incompressible and solid particles of matter of equal mass, either cancellation of the movements of each, or their disruptions, *must* result, and not heat-radiations, as physicists claim. The matter of the world, therefore, is not moving from inherited energy passed on from one object to another, but rather is moving (and also remaining in bounds) in faithful response to the commands of a supreme and universal mental will. Motions are reversed at bounds by a Power existing outside of matter. Other matter-movements-and-energies are completely cancelled by collisions, but never does mental power permit the physical to lapse into complete quietude. Restraint and activity (the fundamental opposites, the source of all the minor oppositions) are the two outstand-

ing characteristics of the material universe. Only a small portion of the total mechanical energy-expression of any one moment, moreover, is inherited from a time very long past. The orbits of the planets, I assert, are being re-created "absolutely" from moment to moment. In these conceptions may be discovered an explanation of gravitation, and conceivable definitions of Time and Space in so far as they relate to the world of matter.

In later chapters I shall endeavour to support this generalization with proofs that relate to some of the scientific knowledge and theory thus far accumulated. So impure is mind to-day, however, so imperfect the reasoning ability inhabiting the brain, that one must agree with Plato as he ascribes to Socrates these wise words:

> . . . When a person begins dialectices, and starts on the discovery of the absolute by the light of reason only, and without any assistance of sense, and does not rest until by pure intelligence he attains pure good, he finds himself at the end of the intellectual world, as in the other case at the end of the visible.[1]

In closing this chapter I shall quote from *Essays Speculative and Suggestive,* by John Addington Symonds:

> The only thing we can be said to know and to be sure of, is the paramount importance in ourselves of mind. . . . If, then, we are mind, and nothing in the last resort but mind, logic compels us to expect mind in that of which we are an integrating element, and from the total complex of which we cannot be dissevered. . . . We are what we are through thought; and we may reasonably infer that this is not limited to our condition, but that mind penetrates and animates existence, forming the essential part of that which was, and is, and is to be.[2]

Again he says:

> The continued experience of mind within ourselves precludes a gross irrational materialism.

[1] Plato: *The Republic,* Book VII.
[2] John Addington Symonds: Essays, *The Philosophy of Education.*

And:

> Either we must postulate the evolution of life and mind out of primordial inorganic elements, or we must postulate a special act of creation whereby the rudiments of mind were communicated together with life to the earliest organized beings.

He surrenders the second possibility, however, for he is an Evolutionist. Evolution permits him to understand, how, through the analogy of the Correlation of Forces (as he puts it), even if mind does constitute the whole universe, "mind appears to us at one period as inorganic form, and at the next period as organized vitality." Science, he thinks, "while establishing Law, has prepared the way for identification of Law with God." He thus sees a basis for religion in the final grounds of science, and is now ready, in advance, to accept this final and still unknown explanation which he assumes the scientific method will probably attain, though he frankly states that not any "disciples of Science at the present moment have drawn this corollary from her teaching." Mr. Symonds probably did not understand how utterly mechanistic, how void of grounds for spirituality, the usual scientific principles are. The method of science, and the imagination of its disciples, may hold promise of a final restoration of spirituality to the universe, but not its present-day principles. These must be radically revised.

CHAPTER IV

THE RELATIONS BETWEEN MIND AND MATTER (CONTINUED)

I had rather believe all the fables in the Legends and the Talmud and the Alcoran, than that this universal frame is without a mind.

SIR FRANCIS BACON.

How definite is our belief that mind and its will-power are non-mechanical? How sure are we that mind has properties distinct from those of material substance?

On this earth conscious mentality is most highly developed in human beings, and our sensations are derived from mental associations with the impingements of the matter-bodies of the exterior world. These energy-deliveries are translated through the medium of a physical body to a centre of consciousness and active power within. The mechanical structures of our bodies are delicately sensitive to every external influence. They receive impressions from every approach of matter, whether the movement is imperceptibly gentle or perceptibly severe. Every blow is recorded, the delicate delivery of a light-ray from a distant glimmer against the organisations of the eye, the harder poundings of sound-waves upon the tympanum of the ear, or even more pronounced, the direct contacts of our bodies with the larger masses of the external world. Not all the blows, however, are appreciated as mental sensations. The eye and ear deliver as sense-data only rhythmic series of blows. We "see" and "hear" only composite effects delivered in orderly fashion through extended space and time. The unit blow is never interpreted mentally, perhaps. Nevertheless, to the extent that man can have mentally obtained sensations from the outside, they originate in the associations made possible by mechanical motions. In energy-deliveries are discovered one phase of

the grounds of man's *awareness* of his material surroundings, the sources of his mental associations leading to knowledge of the qualities and relationships of his physical environment. Messengers from without strike him in formations too compact to pass through his body freely, yet too vigorous to be deflected without influence. These blows are effective, and the effect of them is delivered to the body, and sometimes delivered to consciousness. In each case thought of a certain kind appears.

David Hume said that the forms of knowledge of the environment as derived by man from his usual sensations, were not products of pure reason, but were due to mental judgments of the repeated experiences of contacts with the matter of this world. Not reasoning thoughts standing aloof, but mind-powers as associated with the typical energy-deliveries from certain types of conventional physical structures (the elements), afford us most of our knowledge. We deduce from the typical physical effects received from matter-bodies both their mechanical nature and the laws that govern the relationships of their parts. And as to the single blows, at long intervals, or the unsymmetrical series of frequent blows, if we are to acquire knowledge of them it must be got by means of reason.

It appears to be largely custom to-day that makes us draw satisfying conclusions as to the natures of those physical relationships which we are able to "sense." The repetition of conventional experiences from conventional structural forms through generalized time and space is finally accepted by our minds as proof of the existence of certain types of forms with certain causative powers, and is taken as evidence that similar experiences will be derived again from similar energy-relationships with the same typical structures. Thus, for example, we learn from experience only that heat is associated with flame. A child could not stand at a distance and develop mentally the fact that flames are hot. He acquires this knowledge from the sensational experience of burning his skin—not directly from thought-power conscious or subconscious.

Yet, the forming of a mental judgment from the custom-

ary experience is itself an impressive phenomenon. Hume regarded as a mystery the mental process by which we are led to assume in advance of the event that the repetition of a certain sensational experience with matter-bodies will produce a certain mental sensation. He contended that certainly no process of pure reasoning is involved, for example, in reaching the conclusion that flame (the companion and source of light) will always display heat, or that light itself is not necessarily hot. He was correct in this specific view, at least, for cold light has been produced, and the hot flame of a Bunsen burner is almost invisibly blue. Not all of our judgments as drawn from our customary experiences are correct even as gross generalizations, and most of our conclusions are erroneous in some particular.

Most knowledge of the outside, such as it is, however, is now gained through the mental interpretation of a rather extended sequence of characteristic, and customary, physical events. And the opposite effect, even as a generalization, so far as pure reason usually informs us, might have been possible. But, after one certain sensational experience *has* been derived from one certain set of energy-deliveries it does not require an unusual use of reason to reach the conclusion that the same, and not a different sensation, will be had from the repetition of exactly the same series of mechanical blows. Reason may well inform us that two identical mechanical causes give similar effects. Our chief difficulty springs from our inability to identify two identical mechanical causes. Unquestionably our minds, to begin with, have acquired their knowledge of the external world, not chiefly through pure and unassociated reasoning about the inevitable nature of things, (this we admit with Hume) but almost entirely from noting the results of certain conventional and repeated experiences, and then from reasoning to the conclusion that, when repeated, these same mechanical causes will give the same effects. We have relied upon the principle that the definition of matter,—that is to say, the reality of the effect to be produced by the contacts of moving matter,—would not change from day to day—that generalized experience, such as we can "sense," is orderly. Custom, or the judgment

taken of customary typical sensational events in a world composed largely of certain typical, conventional, and symmetrical atomic structures, moving in certain typical series and with typical momenta, and not the sensing (as an act of pure reason) of the rational plan of universal happenings, is the source of most of our knowing. This empirical knowledge, however, we assert here, is sure to be relative, generalized, of a certain type, and inexact. It must also constantly be changed and revised. And, moreover, it *may* be changed and realized through knowledge-sources that are independent of the sense-data of the specific experiences.

Although it is difficult to indicate knowledge of the exterior world gained otherwise than through some interpretation of some type of sensational association with its moving bodies, one may argue strongly that the usual trial and error method of obtaining information directly from a specific experience is awkward, uncertain, and gross. It has been forced upon us by an inadequate mental understanding. Man's reason, thus far, has been weak. He has possessed little free-will, imagination, creative impulse, or inclination to do more than judge of the influences of his physical surroundings from their usual effects upon his own body. He usually judges directly from the sensations in question. His personal relations with the immediate world of sensations have claimed most of his thoughts. His ability to make use of general reasoning has been too weak a staff to be leaned upon heavily. It has been found wiser to learn through the specific practices. We have thus come to value most highly the somewhat inaccurate knowledge obtained from inexact perceptions of customary types of energy-deliveries of certain limited kinds, and we have, at times, even reached the erroneous conclusion that no other means of obtaining more dependable knowledge was open to us.

Now, however much of this rather inexact knowledge of the mechanics of the universe we may have gained by mental interpretations of the usual specific contacts with its energy-deliveries of certain kinds, some understanding has been gained through a more generalized reasoning as driven by such mental qualities as imagination, creative desire, curiosity,

and by judgments as to what certain unseen things must be if certain seen things are. How, otherwise, would so many practically usable natural laws have been mastered and handed down to us by such imaginative artists as Kepler, Newton, Darwin, Faraday, Marconi, Edison? Indeed, it is more than possible that the human intellect, sufficiently curious, and sufficiently developed imaginatively, and sufficiently broadly interpretative, may, in a future day, discover through the principle of sufficient reason (through reasoning in the most general terms, through thought related to the mind's most general rather than to its most specific experience) the unit-principle governing the energy-deliveries of all composite mechanical effects—a definition so universal and yet so simple and basic (although lying beyond the composite sensational effect which alone we obtain from the usual specific experience) that, when understood, it will reveal the necessary motions and groupings of all the matter-particles composing the universe. We may thus be permitted to appreciate all the possible mechanical energy-deliveries, and, therefore, all their abilities to give sense-data. The specific sensations of experience,—even of experiences of a type that have never occurred before,—may thus be anticipated and classified in advance of receipt.

Thus, a sufficiently strong and imaginative mind acquainted with the Newtonian laws of gravitation might have deduced mentally the necessary motions of the planets in their orbits without making use of the earlier experimental findings of Kepler. Thus, also, the separate principles causing light and heat having been clearly understood, in general terms, it could have been predicted that light-and-heat-radiations might be separated. And one who understands the mathematical theory of harmony may create a melody without associating these sound-waves that have previously been pleasing to the physical ear. In like manner, a reasoning mind sufficiently comprehending the principle that caused the present "spontaneous" radioactivity of radium might predict with certainty the era when lead would itself turn into a spouting geyser.

No, the minds of men have been weak, and because Hume

experienced such difficulty in finding any knowledge that has been gained through a general mental process unrelated to the specific experience, and unassociated with this customary type of sensation, he was led to say that it could hardly be disputed that "all our ideas are nothing but copies of our impressions, or, in other words, that it is impossible for us to *think* of anything, which we have not antecedently *felt,* either by our external or internal senses." And again he remarked: "In reality, there is no part of matter, that does ever, by its sensible qualities, discover any power of energy, or give us ground to imagine, that it could produce anything, or be followed by any other object, which we could denominate its effect."[1]

It may be difficult to find examples of knowledge about external nature derived solely from general reasoning, or from types of experience "not antecedently felt", but this is not proof that such knowledge is impossible. Failing to grasp the simple (perhaps mental) principle underlying all the movements of masses, our weak reason has perhaps been so dazzled by the seeming multiplicity of concrete sensations, and by the almost infinite theoretical possibilities of combining masses and velocities, that we have been forced to use customary sensational experience more than a more abstract thought to reach the opinion that certain sensational-mechanical effects will follow certain mechanical causes—whether previously experienced in like kind or not. It is still simpler, easier, and surer to learn the grosser laws of the apparently systematic mechanical world by experience. It is possible, nevertheless, and even likely, that finally there will be revealed to reason a single principle embracing and defining all the possible materialistic happenings. Indeed, it seems probable that a mental principle similar to that which affords us our reasoning power may give those motions to masses which supply us with our awareness of them. And it seems reasonable, too, that one mind-power should be able to interpret the accomplishment of another. In one sense our knowledge of the moving world springs from a tautology.

[1] David Hume: *Essay, Idea of Necessary Connexion.*

It may be well to say in the beginning that it is a fundamental premise of this book that the general motions of matter are due to the influence of a universal mental Cause. If this concept is correct, it is not difficult to believe that the human mental power, when sufficiently pure, should be able to comprehend even in advance of the actual experience the sensations which will naturally develop from those blows of matter which some related mental power creates. A mind-power may even create the new effect that is desired. The mind may even make experience! This is no more marvellous, than that my mind should understand what my hand is doing when my mind-power has directed and caused its action.

When my will causes my fingers to pinch my arm, I well understand the cause of the pain, and also know how to stop it. No one regards this as in any way remarkable. Why, then, is it incredible that when a purer mental power resides in man it should, through its own nature, permit him to understand not only the cause and purpose of these movements of matter which have been mentally started but also the sensational effects to be received as these motions are surrendered on contacts. If motion is a mental attribute, why should not its fundamental character be appreciated by the mind-power affected by it?

Descartes recognized his own ability to think, but we do not consider this extraordinary, for such conscious recognition is a fundamental attribute of the mental power. Without it there could be neither reason nor will. In saying that the mind recognizes and understands the results which some power of the mind has created, *we are merely defining one of the qualities of mind.* We should anticipate that a perfect mind would know and understand the sensational effects of all possible blows of matter, even intuitively or instinctively. And this knowledge might be open to mind through its realization of its own subjective qualities and powers, and, therefore, without recourse to any sensational experiences. A mind-power may realize through an interpretation of its own properties what another mind-power could and would do with matter.

Knowledge, we admit, is now based chiefly on mental

interpretations of direct physical blows, on the past effects derived from the momenta of certain types of masses. This is the usual beginning of awareness. The attacks of matter themselves and the mechanical results of their poundings, never constitute awareness. The subjective mental interpretation is always an essential part of the acquisition of knowledge. Knowledge seems to be acquired always, either through the activity of the mind with the matter of its environment, or by the interpretation of the nature of another mechanical activity in the environment through the interpretation of the mind-quality that caused it. So far as we know, a rock neither sees, hears, feels, nor understands. Certainly, it does not understand to the *degree* that man understands. Rocks may vibrate throughout their structures to the blows of light or air, or may be permanently altered internally from physical contacts with other masses. They may tingle and suffer change from physical impressions similar to those that strike and affect man, but, so far as we can tell, they are aware neither of the cause nor of its effect. They understand neither the fact that they are being struck, nor the fundamental nature of the mechanical situation enveloping them. At any rate, if rocks have such understanding we see no evidences of it. They do not appreciably wince under the blows, or avoid destruction of structure. If they have that which we call mentality, it is a low and impotent order of consciousness, and is so weak a power that it cannot quickly alter the fate of the mass in which it is stored, or move its own body-organization so as to avoid an unfavourable environment.

Now, for such a life-organism as man to exist, one that must move to obtain the means of living, a rough-and-ready knowledge of the surrounding world is essential, for Nature expresses herself in varying moods. Nature moves unevenly through zones of heat and cold, through times of rain and drought, through seasons and areas expressing first land-fertility and then land-barrenness—times when the life of man may easily be sustained by feeding on the over-plentiful forms of lower organic life at hand, and other times when the daily ration is less than required. The wandering man must, therefore, be aware of the changing qualities of his

environment. He must be able to reason either consciously or instinctively about that which is happening, or else he could not escape the influences of those days when external conditions are destructive.

Unless reason acted directly or indirectly in judgment of customary physical cause and effect (as we may term the usual gross mechanical sequence), a man could not survive the frozen winter of the North. He would have neither the food nor the necessary warmth. The solar radiations in winter are insufficient for the needed pliability and energy of his body. Hence, guided by a weak mental power, and by the understanding of mechanical laws gained principally from specific experience, the man crudely gathers potential heat-radiations in lumps of coal, and later releases these through a discovered chemical action to compensate the waning radiations of the wintry sun. Man must have some degree of conscious understanding of natural laws if he is to exist. Otherwise, he must be so protected by a powerful subconscious instinct, that, like the bear or the crocodile, he may relapse into coma during the months unfavourable to his activities and energetically live only when the natural conditions are favourable.

Even were there no cycles, even if Nature expressed herself uniformly in temperatures, rain-falls, air-currents and the like, a life-organism, feeding upon other life-organisms, and wandering in search of food, requires, first, a body-organization sensitive to the affects of the physical blows of its typical environment; secondly, a thought-force affording an understanding of the expected experiences to be derived from the external world through the judgment of typical sensations derived from the striking masses; and then, above all, it must have the *power to move its own body to surroundings* capable (as chosen and then attained by the mental power) of satisfying its needs. These are and will be the requisites so long as its existence depends upon the maintenance of a delicately adjusted physique. And, in addition to the sensitively organized body, such a life-organism as man must have connective communicating systems capable

of transmitting the external physical impressions to the centres of understanding and judgment.

Nor is the life-form complete with the possession of these attributes. It requires the power to make its own physical body move in proper response to the proper selective judgment. The highest organic character existing on this earth to-day comprises three principle abilities, then, the first being a derivative of the last. These are: the ability to organize a physical mechanism, or body, capable of transmitting inwardly to the understanding the externally received blows; an understanding capable of forming a reasonably correct judgment through the medium of these blows of the different environments surrounding it; and lastly, a mental power capable of making its physical body move according to its reasoned direction—and not in a mechanically ordained fashion.

The life-force must also be able to organize the body-system purposefully so that the normal blows will not destructively disrupt its essential parts before the normal life-period is ended. It must also, at the proper time and in the proper way, be able to gather additional body-substance from the surroundings and thus overcome the disintegrating effect of the physical blows. The damage must, so far as possible, be repaired after each attack so that the next onslought will not find the embattlements down, and resistance annulled. The physical storage battery must be kept charged and empowered.

Now, one of the more important principles emerging here is the ability of the mental power of the organic form to control its own body suitably—not only the organization of its matter, but also the body-movements. Let us enlarge this idea.

As stated in the preceding chapter, reason makes it difficult to deny that the matter of the universe is composed of a mental essence. It seems necessary to admit also that all motions are caused by such a Power existing outside of matter itself. It is not easy to define matter, for every element is now known to be little more than an aggregation of almost infinitesimal entities which cannot be mentally

appreciated separately. Yet, whatever the unit of matter may be, if there is planned accomplishment and significance in the universe, inert and volitionless substance cannot exist forever in its dead state. The matter-principle must represent a temporary stage. We have concluded, indeed, that matter is composed of mental essence. Matter is composed of mental parts which are held only temporarily in that condition which we define as material. Strangely, but truly, this mental essence appears in life-forms, and it, remains there sufficiently to control and to appreciate the physical organism. This non-mechanical power organizes the very physique from which it springs. By the exercise of choice, judgment, and power, it keeps its body assembled, repaired, nourished, and alive for the allotted time, an allotment which itself is harmonious with a superior mental purpose.

As M. Gustave Geley says: "It may be affirmed without reserve that there is in the living being a dynamo-psychism constituting the essence of the Self, which absolutely cannot be referred to the functioning of the nervous centres. This essential dynamo-psychism is not conditioned by the organism; on the contrary everything happens as though the organism and the cerebral functions were conditioned by it." [1] This vital force, apart from its body, is not, then, a mere abstraction, but is something of itself. It is not a tangible, ponderable, material something, but it is nevertheless, the essence of all things. Its quality may be regarded as an abstraction only from the point of view of the most dogmatic materialist.

Unquestionably there is such an operative force in the universe. A modicum of it is in man also, and it is altogether different in principle from physical momentum. It is a power which even asserts mastery over the motions of matter.

It is unreasonable to deny the presence of this force. However marvellous it may seem, man cannot be denied the possession of a will which permits him to move his body. Here the mind unquestionably controls matter. Nor can one deny the presence in himself of a largely subconscious

[1] M. Gustave Geley: *From the Unconscious to the Conscious*, p. 36.

mental force which keeps his body functioning and repaired, restored, and able to endure the life-experience.

If we look at the material world in its larger aspects we reach the same conclusion. If matter of itself cannot or does not move, who, observing the spiralling stars in celestial spaces, the curving planets of our solar system, the molecular activities of gases, the electrons in their quickly repeating atomic paths, can deny the existence of a universal mental power, in obedience to the *Will* of which matter thus moves? Why may we not recognize within our own bodies a minute portion of the power that governs the stars? Is not this mental power, this combination of passive Reason and active Will, to be acknowledged as the master of the motions of matter, and the creator of all significant mass-velocities? Voltaire said well:

> Why does my arm obey my will? We are so accustomed to this incomprehensible phenomenon, that very few pay attention to it; and when we want to trace the cause of so common an effect, we find that there is infinity between our will and the obedience of our limb; that is to say, there is no proportion between them, no reason, no apparent cause; and we feel that we might think to eternity, without being able to discover the least glimpse of probability.[1]

Without will-power our bodies would not move; without vital force they would be as unresponsive, as inactive, as dead as stones; without choice of the one suitable activity in space and time of the many possible to it, the mental power could not maintain its body-organism suitably. And, therefore, whenever inert matter, without equivalent physical cause, begins to move, or changes its average motions significantly, the creative power accomplishing this result is to be regarded as a mental force having will and purpose.

When Descartes said, "I think, therefore I am", did he not mean that because he could think and exercise a mental power, he not only could judge of sensations, and of external

[1] Voltaire: *Essays and Criticisms, The Ignorant Philosopher*, p. 13.

relations of cause and effect, but could also master his own body, and make it move and act in ways that were in some respects independent of physical laws—make it express weakly perhaps, but truly, a different principle? Only because he could think, and exercise will, and choice, and cause matter to move purposefully, and for his own particular benefit, could he say, "I am."

Yet, how could he analyze his own quality with his own quality? Perhaps he could not tell exactly what he was; but he *could* tell what, in part, he was not. There was some non-material character in him, something which when possessed gave him his mental ego, his soul, his being, his living energy, and bestowed upon him a power that transcended mechanical action and reaction, or the supposed inevitable and mechanically determined reflex of a physical cause. There was in him a principle which mastered purely mechanistic terms. He was not altogether matter, and of this he was *aware.* Surely here was an awareness, for once, that came from his mental self, and not from outside physical experiences. He was partly a mentality which possessed a free-will and purpose in its relations with matter, and this freedom of will, and the mind that directed it, were the living vital parts of him. This thought-force, the kind of body it could make for him, and the way it acted and existed in its environment of physical poundings and mental longings, were all that counted for him, were all, in fact, that made him live and be.

Hume explained it as follows:

> The motion of our body follows upon the command of our will. Of this we are every moment conscious. But the means, by which this is effected; the energy, by which the will performs so extraordinary an operation; of this we are so far from being immediately conscious, that it must forever escape our most diligent inquiry.
>
> For *first:* Is there any principle in all nature more mysterious than the union of soul with body; by which a supposed spiritual substance acquires such an influence over a material one, that the most refined thought is able to actuate the grossest matters. Were we empowered by a secret wish, to remove mountains, or control the planets in their orbit; this extensive authority would not

be more extraordinary, nor more beyond our comprehension. [1]

Why mysterious? A significant principle is here revealed. The vital force can and does control matter. The mind of Hume controlled the matter of his body. The same type of power, divinely extended, not only might make mountains move and planets revolve in their orbits, but does actually make them move and revolve. This force made the planets start moving, and now makes them move in curving orbits rather than along independently straight lines.

The ability of the active mind to control passive matter should not be deemed mysterious. Nor must the smallest expression of a revealed principle limit its reality unless the cause of the limitation can be positively proved and understood. Rather we shall learn little unless we attempt to spread the facts observed in the minutest areas to cover the mysteries developed by expansions of numbers and distances. Nor can a true principle readily be altered by being referred to larger dimensions in space, or to longer epochs in time. We should therefore assume that the spiritual experiences developed in the relations of our own bodies cover the widest reaches where matter-bodies move. We must apply this principle even to the movements of the farthest specks of cosmic dust.

Let us accept the evidence of our own bodies, and the evidence of the universe as well, that matter, of itself, *does not begin to move,* and that the mental force has the power, the ability, the will, and the reasonable purpose to cause the significant motions of matter, and does actually cause them.

I use the word "significant" purposefully, because some have asserted that there is no significant, independent, or "absolute" motion in the universe. Disregarding the suggestion that matter might ever be so moved as to override and annul the principle of mechanical Conservation; denying that a power similar to that of the human will might, in its larger relations, be considered as an effective independent agent for such movements, some scientists deny "absolute"

[1] David Hume: *The Idea of Necessary Connexion, Harvard Classics,* vol. 37, p. 358.

motion in matter—not so much in personal, as in universal relations, and they then bend their energies to obtain explanations consistent with this entirely mechanistic theorem.

The universe seethes with motion, although it forever remains within consistent bounds, and however skillfully it may be urged that there is no motion which is "significant," or which represents an increase or decrease in the total expression of active and potential mass-velocity, no explanations within physics have ever accounted for movements which are limited and yet persistent. The mentally endowed Creative Cause is regarded, even by the most loyal Conservationists, as the ancient beginner of the present motions of masses, and they are satisfied to say that motion somehow continues (although reversed in cycles) merely because it is not stopped. Nor do these entirely mechanistic scientists offer a clearer explanation of how a man may move his own body than of how matter first began to move, or how it now continues moving in reversing paths, or how energy changes from an active to a potential state without breach of the Conservation axiom during the time in question.

There is really litfle else in life except evidence of this phenomenon of mentally induced motion. A concrete example of the power of the life-force to control the matter organized into its own body is illustrated in the case of an earthworm, which, when cut into two pieces, grows a new head on one end, and a new tail on the other, and becomes two worms. And, how, except by subconscious mental control of matter, do we repair a cut in our body, or mend a bone, or operate our lungs, or obtain food, or provide heat, or do all the acts that are necessary for a certain particular kind of existence? That life-force organizes and arranges matter is proven again in the human germ-plasm. In the first formative stages the vital force of the organism possesses the same ability to compose a body that is possessed by the earthworm. The germ-plasm when disrupted becomes two living organisms.

We shall attempt, then, to explain that which takes place far away, beyond our bodies, by principles similar to those which operate within us, and near us. We shall try to

expand this intimate principle to cover more of the happenings in the universe. If the method is valid it should afford more reasonable explanations of phenomena than those now current. Indeed, the modern hypotheses are difficult to understand and not easy to accept.

After we have taken a broad compass for the exercise of the power of mind over matter, after we have accepted this power as a true principle, and have attempted to build on this foundation a theory-structure for universal happenings, we shall soon learn whether the different vital phenomena will fit into this architectural plan as suitable building-blocks; whether they will be harmoniously balanced so as to perfect a symmetrical design, or whether the structure will appear ugly and impossible. Here is a force which in its sublimest form appears to be sufficiently vital and imposing to be the Creator of all the movements of matter. It may cause the beginning of movement, and may induce every lack of equality of mechanical effect with mechanical cause evidenced since that beginning. Let us use this power as the X of the algebraic formula that we are attempting to solve, and see whether we can arrive at a satisfying answer.

Why should this power of mental over physical be regarded as "extraordinary" or "beyond our comprehension" —as Hume viewed it. Is it inconceivable that a mental power should have created the universe, and that it is now giving to matter those unbalanced cyclical motions that cause our sensations and evolving lives? It is more strange that parcels of this mental power now appear in earthly forms so concentrated that they can organize physical bodies for their own housing, and, as in man, consciously realize the continuation of their own earthly being and development. Still more marvellous, however, is this plan of broad Evolution which induces a constantly more purified essence of mental power. Indeed, Evolution seems destined to conclude in the creation of a perfected mentality—something partaking perhaps of the pure attributes of the Creative Cause itself. These ideas were briefly suggested in my earlier work, to certain chapters of which I refer the reader.[1]

[1] Hugh W. Sanford: *The Business of Life,* chapters XIX–XXIII inclusive.

Here I wish to emphasize particularly, not the routine of thought, not the methodology of awareness, not the degree to which mind is now free, but the fact that here *is* a mental force which to a certain extent *does* control matter. The beginnings of the motions of the physical universe, and the "absolute" motions since those beginnings, must signify a purposed movement of matter planned and executed by a Creative mental Cause. I am not contending that this general process of Change is being caused by the directioning of the individualistic conduct of each atom of matter by this Cause. Nor do I claim that the general power is now omnipotent. My view of the process has been stated elsewhere to the best of my ability. Grant the presence of the mental power however derived or developed, or driven by whatever motive to move and to restrict the movement of matter, or however potent, and, with this principle as a premise, one may perhaps develop a far-reaching theory.

Voltaire declared:

> This eternal being, this universal cause, gives me my ideas; for I don't receive them from objects. Unshaped matter cannot communicate any thoughts to me; my thoughts do not come from myself, for they occur against my will, and frequently escape the same. We know very well there is no resemblance, no connection between objects, our ideas, and sensations. There was certainly something sublime in that Malebranche, who dared to imagine that we see everything in God himself. But was there not something sublime in the Stoics, who thought that God acted within us, and that we possess a ray of his substance? Where shall we find truth between the dreams of Malebranche and the Stoics? I sink again into ignorance, which is the appendage of our nature, and I adore that God by whom I think, without knowing how I think.[1]

Rousseau vividly expressed the thought that reason *must* postulate the presence of some power outside of matter as the cause of its motions. He said:

> For my part I am so fully persuaded that the natural state of matter is a state of rest, and that it has in itself

[1] Voltaire: *Essays and Criticisms, The Ignorant Philosopher,* p. 22.

> no principle of activity, that whenever I see a body in motion, I instantly conclude that it is either an animated body or that its motion is communicated to it. My understanding will by no means acquiesce in the notion that unorganized matter can move of itself, or be productive of any kind of action. [1]

Because the motions of the universe lack the seeming spontaneity of the motions of animals, Rousseau could not think of the world as a "huge self-moving animal"—as Kepler was willing to regard it—but rather believed that the single atoms, as well as the universe of atoms as a whole, receive their motions from "some foreign source." He thought that some hand must turn the earth, some force urge the sun. He did not conceive that the differences between the movements of animals and matter were due, perhaps, to the proportion that free mental force was possessed by them.

In my earlier work I tried to show that the essential quality of free-will, in so far as it relates to the physical world, consists in its ability to cause deviation in the conventional mechanical routine, and in its ability even to master the material forces and make them obey. [2] In this connection Voltaire said, "Your will is not free, but your actions are." And Count Keyserling writes with more limitations:

> I am free in so far as I am able to will, but as soon as I have willed, I find myself rigidly determined; as soon as a manifestation has been formed, spontaneity is at an end. Thus, freedom may be at the bottom of the body, and God may stand behind all nature, but to imagine that one sees God directly at work in it is just as contrary to sense as to regard one's finger-nails as a free decision of the will. [3]

In my analysis of free-will as the active power of the mental part of man I became so convinced of its presence and capacity that I searched for "absolute" motions in mechanical realms which only a universal free-will might create. It seemed to me that mental power might be an "absolute"

[1] Rousseau: *A Savoyard Vicar, Harvard Classics,* vol. 34, p. 255.
[2] Hugh W. Sanford: *The Business of Life,* Chapter XXI.
[3] Herman Keyserling: *The Travel Diary of a Philosopher,* Vol. I, p. 322.

cause of the motions of matter. Where, then, I asked, is the "absolute" effect, a result that cannot be explained in terms of Conservation? It seemed that through Evolution there was being developed an increased mental power. This indicated that somewhere in nature there should be discoverable a corresponding decrease in the quantity of matter. And yet, as Voltaire said, "I find myself subdued by this maxim of all antiquity, 'nothing arises from naught, nothing can return to naught.' " This meant to me, however, that the expression of mechanical energy *must* change as the expression of mental energy increases.

Reasoning thus, I looked about, expecting to find indications that the quantity of matter *is* being reduced without a cause acceptable to the physicists. Such a result appears to be indicated in the continuous and "spontaneous" radioactivity of some of the elements, in the constant simplification of atomic structure, and in the alterations going on in matter everywhere. Even molecular motions in gases, and the repeating oscillations everywhere, seem to indicate the presence of an active creative Power that is accomplishing something with matter.

And if the reality of the material world is reducing; if matter, while moving, is being transformed into spiritual energy; there should be observable some repeatedly unbalanced mechanical forces, some movements of matter without a later and exactly corresponding reaction, some phenomena measuring in terms of cancelled inertia the rate of transformation of mechanical into spiritual energy. Are there any such manifestations? There appear to be. The force which pulls bodies together with no corresponding rebound of the same bodies is, temporarily at least, an example of such an unbalanced mechanical power. The force that makes the apple drop from the tree is in this category.

Now, in referring this theory of Evolution to the physical world for verification, it will be necessary to relate it to various mechanical phenomena to see whether inconsistencies develop. Other theories advanced by trained scientists should also be considered. Indeed, it might be better for me to stop here—so little is my scientific knowledge—with

this vague suggestion (certainly not a new one,—in its general terms, at least), and leave its development to others. Yet it is difficult to resist the temptation of exploring. I wish to see whether it is possible for me to build up a satisfactory argument; and this work represents that attempt.

The material universe moves with precision, with seeming uniformity, with apparently ceaseless repetitions of meaningless wheelings; but I shall hope to prove that these energy-consuming repetitions are nowise exact. It appears to me that substance gradually curves into new relationships planned by, and passively corresponding with, the will of a directive and active universal mental Power, just as an ocean liner works up to its pier under the direction of its captain. At some finally attained and mentally determined mooring, matter will end its motion and being. At some place, and in some time, the existence of matter will cease, and its era of sensation-giving will be no longer. Yet, so gentle is the curve of this motion, and so long its time in comparison with the life of a man, that the physicist inclines to deny such response to a mental rudder. He prefers to think that there is no "absolute" or finally significant motion anywhere, and strongly doubts the permanent attainment of any planned purpose. Man experiences so little of time and observes so little of the universe that he cannot be sure there is any general average accomplishment that would afford a refutation of the cherished axioms used in his every-day physics. Many deny the reality of an uncompensated Change that might signify a permanent and non-reacting accomplishment. This sea of matter is undulating, they grant, but surely not flowing, nor evaporating, nor changing permanently. According to such a concept the universal motion means nothing. In the broad view the waves of matter are opposed and, therefore, in one sense, self-compensating. They may be regarded, it is thought, as self-cancelling, and perhaps, as gradually reducing in energy-potential. The placid fluid was started moving somehow in the distant past without planned accomplishment in view, and now the positive and negative waves merely continue oscillating aimlessly and "spontaneously" —although in repeating cycles displaying reversed motions.

The wave-substance does not even wear from the movements, for matter, considered as a whole, mysteriously enough, has no internal frictions to make it either wear or cease moving. It is reasonable, they claim, that matter should oscillate forever without accomplishment, average retardation, or significance. This willingness to move forever from an inherited shove, without purpose and without ending of motion, is one of the reasonable attributes of matter, the physicists claim. The reversed motions do not even call for an "absolute" power of restraint, and the curving cycles do not represent the consumption of "absolute" energy.

This is the almost incredibly materialistic hypothesis first formulated officially by Helmholtz to be known then as the doctrine of the Conservation of Energy. It was even latent in the minds of Aristotle and Democritus, and was made possible, it was thought, by "actions at a distance." This doctrine was hailed as one of the great eternal truths. It was believed to be a necessary postulate if the Newtonian laws were correct, and who, pray, in the days of Helmholtz, would deny their exactness? Do not the very planets and stars move in perfect correspondence with these principles?

Do they indeed? There are spirals in the heavens that cannot be accounted for. Nor does light behave as it should. Light has energy, and this energy, according to Newton, should be measurable as a definite proportion of mass and velocity. Yet the energy-effect of sunlight, its very speed, it is claimed, is the same amount whether the earth is moving towards or away from the sun. Here is an increase in the relative motion which, it is said, has no effect on the velocity or energy of light. This is quite contrary to Newtonian principles. It even appears at first glance to be contrary to the eternal truth, the Law of Conservation. To be sure, velocity and energy are being increased and diminished apparently without mechanical cause describable in terms of Newtonian laws.

This, however, is only the beginning of the smashing of images. Inconceivable activities are proceeding within the atoms of ordinary matter—such as these composing our own bodies. Energy is being added to (and subtracted from) mat-

ter with little apparent regard for the Newtonian principles, and in seeming disregard of Conservation. Radium (and many other elements) "spontaneously" disrupts and emits energy into the universe without appreciable cause, and a gravitational force attracts the apple from the branch of the tree to the world with a continuing power to which there never seems to be a compensation in kind, and for which there seems to be no energy-source. Thermal motions, moreover, repeat themselves in backward and forward oscillations, and there is no explanation of the source of energy of these reversals. Nor does Conservation seem to apply to the motions of molecules. Their motions are reversed from the bounds as if both bounds and molecules were perfectly elastic—although such elasticity, as an original source of movement, is not to be explained. And yet, when the molecules collide with one another, they deflect as if they were completely inelastic. Nor can one identify the force that causes the reversing orbital curvatures of the planets of the solar system or of the atoms.

Some of these inconsistencies, however, and particularly those of gravitation and light, may be explained by the acceptance of an Einstein hypothesis. Perhaps we may modify the Newtonian formulas by an almost negligible addition, one that brings Time itself into the formulas as a variable. Let Time (minutes, seconds, and hours) be regarded as varying in some inverse ratio to relative motion at the speed of light. Suppose this, if you can, and then modify the formulas of motion and energy accordingly. Here is a "fourth dimension" if you please, a Time-element (and yet a constant space-time relationship) which at the speed of light makes the relative motion between two frames of reference disappear because it proportionately makes the seconds and minutes of one frame dissolve into nothingness. Consider this, and you may learn how, when Newtonian formulas are thus modified, the principle of Conservation may still be held—at least in certain relationships. When Time is thus interpreted and formulated the things contrary to Conservation which light and gravitation appear to do, may now be explained as non-existent. The seeming inconsistencies are restored to

consistency by the change in Time, and also by the curvature of space-time near unusual mass-density which the very movement of the observer relative to the source of motion induces.

How simple this is! The followers of Professor Einstein, it is true, may overlook for the moment other phenomena conflicting with Conservation, but they cannot be expected to explain everything at once. There may even be some inconsistencies in the Einstein theory of gravitation as Mr. D'Abro so ably demonstrates in his *The Evolution of Scientific Thought;* but there are also fundamental objections to Newton's law of gravitation (see p. 321 of his book). However this may be, if a hypothesis makes Conservation possible in realms where for the moment it seemed to have failed, should we not accept the new idea, temporarily at least, with the hope that later theories equally ingenious will tell us why elements "spontaneously" disrupt, and how atomic particles jump from one orbit to another without consuming time in the movement, how air-molecules oscillate forever back and forth in a balloon, how electrons revolve around congested atoms without interference from the physical environment, how radiant energy is emitted and received in multiples of a certain minimum quantum-quantity, how one force of attraction makes two tidal bulges on opposite sides of the earth and in opposite directions, and how a child, by stamping his foot, can make the universe tremble in new fashion?

As I do not believe in the validity of Conservation, I reject the hypothesis of Einstein. At the same time I reject the idea that there is perfect exactness in the Newtonian formulas. These formulas must be relative if the principle of mechanical Conservation is relative. To identify the relativity of certain aspects of classic mechanics it is necessary only that we disclose departures from Conservation in the mechanical routine. I regard the relativity of the Newtonian formulas for many of the usual practices within the pool of matter as being proportional to the rate at which matter is being absorbed or transformed into spiritual energy. I therefore propose a formula somewhat as follows, "Relativity equals Evolution." Or, to put it in a different way, "The

mechanical truth equals Newton's formulas minus the influences and results of the evolutionary Cause."

The laws of Newton doubtless require changing for some of our usages in some such way as Einstein has altered them. Other principles such as "radiant energies," "cohesions," "attractions," "elasticity," "thermal motions," must submit to radically different explanations. This, however, is not the most important consideration. The philosophy of Einstein appears to me to be erroneous. My reason for changing the formulas is the exact reverse of his. My change (based, I believe, on a more correct, or at least on a more reasonable philosophy) preserves the correct result and what (I hope) is the sounder view. Furthermore, the changes in formulas that I shall propose will be as necessary for the phenomena of one frame of reference as for the relative motions between frames. The principle of mechanical Conservation nowhere applies exactly. Everywhere the mechanical formulas based upon it require correction.

Postponing this argument, however, let me re-affirm my premises. I believe that the mind has power over matter, and that, since it appears evident that the Conservation principle is constantly being nullified in a man's everyday life by his own free-will, he will be justified in believing that it is also being overruled by the general mind-power in the farthest reaches of space. The principles of matter and mind, and their relationships, must be consistent throughout the universe. Even if a man's freedom cannot alter the larger relationships of the matter moving into contacts with his body, it can exercise a measure of independent control over some of the physical conditions of his environment. Of this he can be assured; and he can confidently predict a wider spread of this same general type of power—and its reasoned accomplishment.

Count Keyserling has said well:

> Mind can move mountains. (The usual wording which give such power to faith is too narrow and, moreover, liable to be misunderstood; it is not confidence as such which brings about the miracle, but faith gives to the mind complete possession of its power.) Of course it can do

> so. It is ridiculous to doubt this truth, almost as ridiculous as the desire to prove it in particular. For what do I do when I will something, when I think, when I act? As mind, I influence matter; in principle there is no difference between the most ordinary gesture of the moment and the miracle which a magician may perform.[1]

I believe in man's free-will, but I stipulate also that a larger and more transcendent Cause is displaying its power over matter and its planned accomplishment. The measure of this accomplishment is Evolution, through which mind-power appears and the matter-quality disappears.

The human race seems to have been developed from an earth originally a hot gas. The incandescent world-nebula seems to be the only possible source of the organic forms of this earth. It appears, then, that, mind-power has been created directly from matter—from matter charged with motion by a universal mental power. I contend, therefore, that the universe is now dualistic (two arrangements of one essence), and that only one principle, the mental-power, has volition, reason, and purpose. It alone has the power to create original motion. I believe, therefore, that progress is mentally accomplished and that the motions of matter have mental significance.

Truly, most of what we observe may be the vertical waves on a stream that is flowing. These waves, in so far as they exactly repeat as undulations, are insignificant—but only in that they have no "absolute" effect within the particular energy-volume. Yet, there would be no undulations, and no maintained energy-volumes of uniform proportions unless there was also somewhere an unbalanced energy-delivery. Hence, even these seemingly important movements are significant in what they *represent*. Also the limitations of the movements are significant! There would be no reversed waves unless the movements were repeatedly restored by an outside Power.

A stone drops into a pond. The action of the stone brings about new consequences even in this fairly uniform pool of

[1] *Ibid., The Travel Diary of a Philosopher,* Vol. I, p. 316.

created molecular motions. A new movement with potential power has now been started which must finally end. Yet, after the new movement has been created, it is these inconsequential and balanced motions of the waves, within the sustained (and maintained) energy-volume of the pool, while merely repeating—a positive and then an equal negative movement (and positive reversals of motions, too)—that men incline to observe. They seem to disregard the "absolute" quality of that which caused the waves, the "absolutely" new quality-expression which they represent, the "absolutely" new effect which they will finally deliver, and the "absolute" use of energy that now reverses their motions, and which even creates the energy-volume that makes them possible. Many writers also close their eyes to the flow and force of the current of Change which is to be discovered within every fluid pool of matter. Thus they overlook everything that is "absolute," everything that denotes uni-directional progress. Many misinterpret the cause of the reversed motions. Perhaps man's vision is too weak to observe the limiting bounds (the largest or the most minute) where the use of "absolute" power is needed if motions *are* to be reversed, and if structures *are* to be maintained. Man also observes only grossly that which happens within the extremes of what incorrectly appears to him to be a balanced pool of mechanical events. His life-period is too short to mark the movement, or, may be, he has conceived of nothing so fixed that it may be used as a measuring base.

Nevertheless, because of the phenomena external to, and also within my own body, I assert that there *is* a mental freedom which exercises its will over matter, that there *is* progress in mental realms, that there *is* change in mechanical forces which has no later mechanical compensation.

Keyserling has said:

> . . . that the spirit is more powerful than nature; that no natural limitation is insurmountable, that there is a divinely creative power in the soul of man. And this is really so. And if this is correct, if humanity will get so far one day that it can live entirely in the spirit, then it will not longer need to recognize any order of nature

as unalterable; then what to-day is refuted by all facts will be found true.[1]

I see no everlasting cycle, no uniformly swinging pendulum, inanely swinging, forever with equal actions and reactions, forever reversing itself over the same path without the use of new power, and perfecting ceaselessly a mathematical average of condition, which, when consolidated into its composite mechanical effect, points only at the vertical zero. I deny that man has the right to affirm that the principle of Conservation is an eternal truth, and that the history of life is forever sealed thereby as a blank page. I believe that the motions of matter represent a huge spiral of generally caused activity, and of specifically caused effect—a gradual alteration of physical being under the control of active will—a process that will continue until it ends in the final disappearance of all matter and its energy. I purpose to follow this hypothesis—so different from that accepted by the classic physicists and scientists—whither it leads.

There *is* an "absolute" power of will even in insignificant man, but it is a weak power. The will of man may not influence the general plan of the Creative Cause. Nevertheless we must remember the truth of what Emerson said: "All power is of one kind, a sharing of the nature of the world. The mind that is parallel with the laws of nature will be in the current of events and strong with their strength."[2] Or, as he remarked: "Let us build altars to the Beautiful Necessity. If we thought men were free in the sense that in a single exception one fantastical will could prevail over the law of things, it were all one as if a child's hand could pull down the sun. If in the least particular one could derange the order of nature,—who would accept the gift of life?"[3]

Matter, when directed by will, does the latter's bidding without hesitation or delay. Rousseau expressed similar ideas, but did not pursue the reasoning. He wrote:

The first causes of motion do not exist in matter; bodies receive from and communicate motion to each

[1] *Ibid., The Travel Diary of a Philosopher,* Vol. II, p. 358.
[2] R. W. Emerson: *Essay on Power, The Conduct of Life,* p. 58.
[3] *Ibid., Essay on Fate,* p. 51.

> other, but they cannot originally produce it. The more I observe the action and reaction of the powers of nature acting on each other, the more I am convinced that they are merely effects; and we must ever recur to some volition as the first cause; for to suppose there is a progression of causes to infinity, is to suppose there is no first cause at all. In a word, every motion that is not produced by some other, must be the effect of a spontaneous, voluntary act. Inanimate bodies have no action but motion; and there can be no real action without volition. Such is my first principle. I believe, therefore, that a *Will* gives motion to the universe, and animates all nature. This is my first article of faith. . . .
>
> The Will also is known by its effects and not by its essence. I know it as the cause of motion. . . . That an inanimate body lying at rest should move itself, or produce motion, is incomprehensible and unprecedented. [1]

As Rousseau remarked, for inanimate matter to move of itself is "incomprehensible and unprecedented." According to Hume, this is true because, if unprecedented, it is incomprehensible. But, if what we know as matter had ever moved itself, would we then call it matter? If matter should suddenly become "spontaneously" active, and move as if by its own volition, would we not be obliged to call it alive? Is it not better to describe matter as that something which never moves except in harmony with mechanical principles, in accord with a routine of equal action and reaction, according to a certain aspect of the law of the Conservation, and according to the accepted definition of motion and inertia—that is to say, when (and only when) moved by a power outside itself, but never from curiosity, or whim, or instinct, or from any sort of internal volition of its own? Does this definition, however, really define matter to us?

Radium "spontaneously" disrupts when seemingly uninfluenced by contacts with other matter and sheds particles of itself into space with enormous velocities. Yet, to be sure, one might say that every piece of radium may be relied upon to act like every other piece, for no one particle of it displays the ability to deviate from the usual. There is no local, indi-

[1] Rousseau: *A Savoyard Vicar, The Harvard Classics,* Vol. 34, p. 256.

vidualistic volition in each piece of radium that makes particles of it move without being moved. If some volition *does* cause the eruptions of radium, it must be of a universal nature. Otherwise, why should all radium perform similarly? And is radium free from important external contacts? Here, however, is matter behaving in a way that Rousseau regarded as "incomprehensible and unprecedented." Here is a mystery of mechanical movement which cannot be explained in terms of thermal movements (themselves still unexplained), or in terms of unexplained powers acting at a distance. And yet, if we are to hold to our definition of matter as of itself motionless, these "spontaneous" radiations must be explained as the result of some universal act of volition, of some general expression of mentality or free-will such as my theory calls for, of some cause that applies equally to the radium in every star and planet and meteor in the universe. May they thus be interpreted? We shall later make this attempt.

Other universal forces seem to act significantly. One, we have seen, is the force which seems to draw matter towards matter—gravitation. If I release a stone from my hand it immediately moves towards the earth and the earth moves to meet the stone. And yet the stone and the earth are that which we designate as matter. This principle is universal. It applies, as Newton and others discovered, between the suns and their planets. If it never seems able to concentrate matter in "absolutely" solid structures, at least it seems to be able to deflect the straight-line motions of the denser bodies sufficiently to create repeating orbits. It does this much almost universally—and never accomplishes more. It is thought by scientists that gravitation is produced by "forces at a distance," and not by the blows of masses, but gravity is either due to material contacts, *or else it is a force outside our definition of matter and its energy of inertia.* Professor Einstein, as I have said, attempts to prove that there is no such general and separately distinguished force as gravitation, and here, it seems to me, there is parting of the ways. Those who believe in a significant evolutionary Change and accomplishment can no longer journey with the

strict materialist, with the ardent Conservationist, with him who denies reason and purpose in the world, who sees no distinctive place, or separate reality and power in the world-relationship, for that mind with which he judges and theorizes.

If there is no "absolute" motion, if there is a perfect mechanical Conservation, if all the movements and energies in one direction are exactly compensated by (because they create) equal motions and energies in the opposite direction, as must be the case if Conservation is to be upheld, then there cannot possibly be any such average expression of energy as gravitational "attraction." All forces must be mutually self-compensating in the average and, if so, self-annihilating, and non-existent as a whole. If we uphold the principle of Conservation we must be as consistent as Professor Einstein, and deny "absolute" motion and the separable reality of gravitation as a force-principle distinguished from the force of inertia in motion. Time must then be changed by relative motion, space-time *must be* warped by the presence of distant mass, space-time must be a uniform continuum in which motion proceeds naturally in curves that deflect proportionally to the nearness and amount of the mass in the environment, and the contentions of Professor Einstein must be accepted as reasonable and necessary. These unprecedented forces, and seemingly "absolute" tendencies, having been destroyed by his new mathematics, they no longer exist. Time itself must be regarded as the Cause of change, and as the Deity presiding over the flux, and even creating it. The nature of thought then remains a mystery, but still we have the consolation of the scientist who, like Sir James Jeans, says in *The Universe Around Us,* there is "No need even to worry much about apparent contradictions." Again he remarks: "It does not matter much whether the formula admits of a mechanical explanation or not, or whether such an explanation corresponds to any thinkable ultimate reality." Sir James says that reasonableness may be dispensed with in science provided that the formulas describe "the phenomena of nature with simplicity, accuracy, and completeness." Can it be possible that he supposes scientific formulations can

now be thus described? Indeed this is a far-reaching, almost humiliating confession of his. If reasonableness is not to be attained or sought, how, pray, can we rely upon any of the reasoned judgments taken of any experiences?

Now let us ask what would happen to science if the power of mind to make matter move is acknowledged both as a local and universal possibility? Unless we consider free-will as a disguised form of mechanical force, unless we agree that it, too, follows the mechanical law that physical reaction equals the action (at a different time and place, to be sure), how can we admit its presence and influence without abandoning the idea of exactness in the mechanical explanation? This independent force, whenever it acts, will cancel the necessity of equal actions and reactions. Its accomplishments must then be regarded as "absolute." When however, one traces to this source of power, one can understand it, for it then is seen to be what it appears—namely, an "absolute" power acting always in one direction.

We have come to a point where we *must* take sides. Can the power of mind, as a distinct and separate principle, and not as a physical reflex, make matter move, or can it not? Can or cannot a mental Creative Cause have originated the energy-conditions of the material universe? Can or cannot the volition of a supreme Cause *now* be the origin of the limited motions of matter bodies (whether molecules or worlds) and of the so-called "attractions" of matter? Is there an independent force of mind and will, and has it "absolute" control over matter? Are such qualities as curiosity, imagination, creative impulse, choice, reasoning ability, endowed with the power to rearrange material forces according to their desire, and to express thereby a result that is not mechanically founded?

When the child stamps its foot and the world vibrates in a new fashion at this particular time, is there inevitably some counter-active and balancing and inevitable mechanical impulse at this particular time and in exactly the right direction that perfectly compensates the continuing vibration as thus created? Is the child's mental impulse nothing but a mechanical reaction, and does this activity mean nothing new

in regard to the world under its foot? Would the world be exactly the same if there had been no child who thus originated the motion? Would the same motion have been produced at that time and *in exactly the same fashion* had this life-organism never been born? This is a vital question. I have already taken sides, seeing no escape from the reasoning of many thinkers. I agree with M. Bergson when he says:

> The whole of matter is made to appear to our thought as an immense piece of cloth in which we can cut out what we will and sew it together again as we please.
>
> Suffice it to say that *the intellect is characterized by the unlimited power of decomposing according to any law and of recomposing into any system.*[1]

Here is perhaps the most vital issue that can come up for human consideration. If the mental power has a reality that is distinct from mechanics, it *must* have its own individuality, and if it *does* express itself, it must overrule mechanical power when the two contend, for, otherwise, mental power would have no importance and no essential or distinct reality. If the mental powers cannot express their own properties in reference to the properties of matter, the world-motions, which are the source of our sense-data, will proceed on a basis of pure mechanism, and even sensation will respond to a mechanistic definition. This would leave nothing but mechanism in life. Mind *must* rule matter, we believe, and this source of independent power must lie outside of matter. We usually recognize mental power, to be sure, only in its associations with matter, but this does not signify that mental power is a disguised or unusual type of mechanism. On the contrary, mind-power exercises an independent freedom of action with regard to the physical. There are forces in the universe besides matter in motion—namely, that force which *gives* inert matter its motion. Inertia itself displays no force-principle. The physical, we believe, is an arrangement which is satisfied with its inactivity and peaceful possession of space. As Professor Santayana said:

[1] Henri Bergson: *Creative Evolution,* pp. 156–167.

> That matter cannot, by transposition of its particles, *become* what we call consciousness, is an admitted truth; that mind cannot *become* its own occasions or determine its own march, though it be a truth not recognized by all philosophers, is in itself no less obvious. [1]

Volition is nothing less than a power possessed by the living and not possessed by the dead. Rousseau's conception that the planets did not move in orbits of their own volition was valid. In the power and quality of the mental is to be discovered an explanation of the fact that radium erupts, that the stone in the air and the earth draw together without later tendency for them to react from each other an equal amount, and that the molecules of gases, and the parts of all things, unceasingly move back and forth in cycles large or small.

I respect Einstein for his consistency, for the logic of his deductions, because his theories are necessary if the Conservation principle is to be taken as perfect and universal. Nevertheless I regard his premises as unsound. I believe he took the wrong fork in the road. I do not accept Conservation. Rather I accept the reality and freedom of my mental power.

If we take the path that denies the separate existence of a free and potent mental power in the universe we have no right to suppose that the material world might be subjected to any influences outside of itself which could increase or lessen the amount of its energy-expression. We should be obliged to agree with Einstein that there is no "absolute" motion; that all the motions of matter balance and exactly compensate; that the motions (as averaged through time and space) about the common centre of energy neither increase nor diminish; and that there is no such average expression as a restraining force with "absolute" power.

To conceive of this literalness to which our reason (if it is reason) when tied to this premise inevitably brings us, we should have to agree that Time might be so changed by relative Motion that when an object moves with the velocity of light there would be no such thing as Time for it to

[1] George Santayana: *Little Essays, Body and Mind*, p. 15.

experience. We should have to agree with Einstein, because we should be brought to this unreal pass by an unanswerable logic.

Yet, even if we agreed that there was no such thing as a mental power able to give independent and "absolute" motion to matter, we should still be hopelessly confused when we tried to explain other happenings. We should be unable to conceive of this growth of mind that proceeds with Evolution—this change of species along mental routes that has led finally to the creation of a man who could say "I think, therefore I am." We could not conceive of thinking at all, or of what it might mean; for, if a thought were nothing but a mechanical reflex, mechanically caused and directed, and if a definite mechanical impulse exactly balanced every mental impulse, then, however much this mental power developed, it would be of no significance. Being nothing new, merely mechanics in disguise, its growth would mean less to us than the discovery of another grain of sand on the shores of the sea.

Although we can respect the Einstein hypotheses because of the need of them if one would harmonize certain experiences with the law of mechanical Conservation, we frankly assert that we cannot conceive that the Conservation hypothesis might be true, for we cannot suppose that the activities of mental energy might produce the results that would obtain were there only mechanical energy. We can no more conceive of will-power as being equivalent to conventional mechanical momentum than we can think of goodness as the equivalent of tallness. The two principles seem utterly incommensurable. To the degree that we posit our faith in the presence of two kinds of organisms, organic and inorganic, we believe equally in two kinds of power-expression—the blow of moving matter when colliding with other matter, and the external mental power directing and causing the motions. Just as we are sure that matter, of itself, is inert and expressionless, so are we confident that it never moves except in obedience to a mental will. We believe that every energy-delivery is indirectly an effect created by mentality.

If this opinion is wrong, if we have not chosen the right

premise for an interpretation of life, one may as well throw this book down, for nothing in it is worth while. But if we have made a proper distinction between material and mental principles, the theory leads far in another direction, even to an abandonment of belief in the exactness of that Conservation to which physicists have been wedded; to a disclosure of the fallacy in the Einstein hypotheses; and to clearer explanations of some of the mechanical phenomena. We should disclose some of the scientific illusions.

If I had believed with the materialists, I could never have written *The Business of Life,* for in this earlier work I attempted to devise, through the power of free-will, a system of more satisfactory government. I argued that man might exercise a better control of the physical world. If, however, either Newton or Einstein were correct, such an effort would be futile and ridiculous. If it were impossible for man's will to alter in any way the movements of matter no improvement in government or conduct or living could be expected, for man's life in his physical body is principally composed of those mental sensations and physical body-changes which are derived from these collisions with moving matter-bodies. These materialistic wave-undulations could neither be leveled nor reduced, for, unless mind possessed the power to control matter, it could never subdue impotent oscillations, however inane.

Positive energy is required to set up or break down those vertical waves which, while they represent powerful potential forces, signify nothing in themselves so long as changeless, and nothing in regard to the rising of the tide.

If the Conservation theory were sound, there would be no significance in life, no art in living, no possible progress. All that we know of accomplishment, development, and improvement in the past, must then be regarded as a myth, an unreal sentimentality, a peculiar and accidental strain and stress of mechanical forces, a something which will soon cease to be, and which meant nothing while being. We should be mere stones, after all, without imagination or intelligence, or real power to move, without love of beauty, or inspiration, or creative impulse. We should be nothing less than a huge

sham, a dream lifting its head out of the mire towards blue clouds and sunshine, happy for the moment in its promise and vision, but nothing more vital in the end than a bubble of the mud where water has settled—soon to be flattened down into sullen matter again. If such were our belief, pessimism would be our religion, and destruction of a continuing species our ambition.

CHAPTER V

THE DEFINITION OF MATTER

The vision we have of the material world is that of a weight which falls: no image drawn from matter, properly so called, will ever give us the idea of the weight rising.

HENRI BERGSON.

We have defined matter as being something which never appreciably moves of itself, and which, when it seems to be moving spontaneously, is either responding to a universal change in the equilibrium of pressures, such a cause as seems to be evidenced by the eruption of radium, or else is moving because it has been struck by another moving body,—or, perhaps, is being influenced at a distance by the presence of other matter. The inertia of matter, however, not its willingness to accept motion, is our main theme here. Later, particularly in chapters XX and XXI, I shall consider force-relationships.

Whenever motion is transferred from one body to another through contacts, uniform results, so far as we can tell, have always appeared from identical physical conditions, whether the action takes place on the earth or on distant stars. Experience seems to have proved that sensations derivable from the blows of matter may be accurately prophesied, provided only that environmental conditions are identical with those of a previously charted experience. For this reason, formulated laws are used in physics with assurance.

One important attribute of matter makes its motions significant, and therefore takes a vital place in its definition: Two material particles are unwilling to occupy the same place. Except for this exclusiveness a moving body would be unable to deliver a blow. Two stones resist enormous

pressures before they will accept a smaller total volume than they occupy separately. Water will penetrate the pores of a sponge and drive out the air, but the air and water atoms refuse to occupy one space; nor does the water take the room occupied by the structural atoms forming the sponge. Atoms, composed as they are of many separated corpuscles held in a dependable structure by the force known as "cohesion," may be squeezed into a smaller volume by a pressure sufficient to reduce the open spaces between the electrons; each electron may have, for aught we know (it seems to have), a structure of its own, with open spaces between separated parts, and might, therefore, be compressible; yet we must suppose that there is some ultimate and smallest bit which is not composed of other particles, and which, therefore, is *solid, incompressible, and rigidly inelastic.*

Inertia implies the possession somewhere of perfect physical solidity, rigidity, and inelasticity, for, otherwise, the matter-particle could neither deliver nor receive momentum as it does. Except for resistance to aggressions, and jealous retention of its extension, particles would pass through one another like ghosts. The smallest particle, or unit-particle as we shall call it, is significant mechanically through its space-monopolizing quality, through its refusal to allow another particle to share its volume, through its innate rigidity —and also through its acceptance of motion. Inertia, or resistance to aggressions, is a fact of common experience. We cannot doubt that the unit of matter possesses this quality. Indeed, no property could pertain to the groupings of matter-particles unless it first applied to that smallest bit which in multiple composes the largest structure. Matter is definable as a material principle only so long as the unit-particle has this incompressibility, this rigid inelasticity, only so long as it does not start or stop moving by itself. If the material particle should surrender these properties, it cannot, to this extent, be said to have material characteristics.

The unit of matter, then, may be defined as that smallest of all particles which possesses rigid solidity and inelastic compressibility—and, through these qualities, inertia. (Elas-

ticity, as we shall perceive later, is the quality of a composite in a certain environment, and elasticity can never be perfect.) As the unit of matter cannot be composed of other still smaller particles, it must be homogeneously solid. Indeed, it must possess its rigidity to the point of becoming non-material at any time that these identifying attributes must be surrendered. It can never be divided and still retain the typically physical properties. We assert even more: The unit of matter cannot yield the slightest to a blow, for, if it might possibly take a new contour under pressure, if its surface might be in the least bent, then it cannot be the unit, but must be composed of smaller parts which are possessed of firmer and more dependable physical characters than this yielding body.

The true unit of matter, the building-block of all larger bodies, then, is entirely rigid in its mechanical being; and this jealous retention of a constant volume by the unit is one of the sources of the recognized physical attributes of the composite. Because of this rigidity in the unit of matter, and because of its willingness to accept motion, a composite object can also receive and deliver motion. No power contained within the corpuscle itself, however, can reverse or accelerate its motion.

The motions of matter may be more or less intense. There may be different time-intervals between the blows of the separate corpuscles composing a composite structure, the momentum may be delivered by a structure as a whole over a wide or narrow front; yet, matter is revealed to us, affords us sensations—*is* matter to us—only because it delivers some of its motions to us, because the messengers from the material somehow do reach and become associated with the mental principle—or, because some of our organic mental power is required to give motion to matter. Matter is known to us from appreciations of the sensations derived from its quality of solidity, but only when this solidity is accompanied by motion—and perhaps also, for the most part, by motions at regular intervals. Solidity, in empty space, without contacts, is unknowable. All differences in sense-data spring from variations in the velocities, arrangements, and frequen-

cies of the rhythmic blows of the smallest bit, of that which is solid—of that, indeed, which in its larger groupings is composite and partly yielding. We do not see this unit of solidity. We neither hear, taste, nor smell it; but its being is proved to us. Diluted with volumes of empty space, the characteristics of this smallest particle are made known to us almost exclusively in terms of composite group-effects. Yet, even at the time we make these interpretations of the environment through the medium of yielding and *elastic* composites, or through rhythmic series of blows from separated corpuscles, reason tells us that rigid *inelasticity* must be the basic characteristic of the invisibly small unit of matter.

Reason does not tell us, however—as many seem to have supposed—that the unit of matter has *infinite* rigidity, and that it may never disrupt. Quite the contrary! Infinite rigidity and indestructible inertia are not to be assumed, for in such changelessness one gets no glimpse of the story of life. The definition of matter tells us nothing about its permanency—it merely tells us about matter *so long as it is matter.* When this unit *does* disrupt—a phenomenon the reality of which the fact of Evolution appears to demonstrate—one would think that the solidity of this smallest bit would disappear. Certainly, by disruption, the smallest bit becomes less in size than that which is the typical unit of matter, and these smaller parts could not display the characteristics normal to the larger. If, moreover, the material properties are due to the fact that the smallest bit of that which is known as matter clings constantly to a certain volume of space, then, when this cohesion has broken down, when the strain on this smallest bit has compelled it to surrender its solid structure and its exclusive possession of space-volume, surely it then no longer has the typical characteristics of matter. It cannot be the smallest bit of substance both before and after disruption. Yet, if it becomes less than that which is the typical building block of the material world, if it becomes less than that which gives matter the unit measure of its revealed properties, how or why might it still display these properties?

This is a somewhat difficult concept, but it is vital, and must be grasped. Perhaps an analogy will help. It is very

difficult for us to think that matter-quality might disappear, for we have been led by experience to think of matter as the one permanent character about us. Yet, we can think of radium disappearing, and we realize that its typical qualities go with it. We can think, too, of water disappearing, and of its qualities going with it. Indeed, there is not a single element that we can now regard as surely permanent. The different elements may all disappear and their qualities will disappear with them. Why, then, should we be so positive that the invisible building-block common to all of them, and which we have probably never identified by itself, should be forever permanent? Have we not this idea ingrained merely because we have come to depend upon the permanency of the elements which we make use of, and because we have never had a realizable experience with this smallest bit of substance when it *did* disappear? But, if it *does* disappear, even though we do not sense the action, nor miss the specific presence, why shouldn't its material qualities disappear at that same time? Are not the qualities of the aggregations of particles composing all our elements merely multiplications of the quality of each of the separated bits as they appear in different types of cohesive structures? Certainly the quality of a composite like radium is more than its quality of being composite. It is rather the quality derived from the repeated effect delivered by the unit of matter composing the piece of radium as repeated through the medium of the composite structure. There seems to be every reason to assert, then, that when this smallest bit of typical matter *does* disrupt, the typically physical properties of this matter-particle, as blended into its various aggregations, and as then recognized and experienced by us, will disappear, and the opposite, or negative of the typically physical, will then appear.

This last is my vital premise. Only this happening seems to account for the evolving Change in the world that everywhere impresses us with its reality. We have arrived at a concrete definition of matter while it exists, but at the same time we must naturally question whether matter is surely matter for ever. Have we a valid reason for believing in the

inevitable permanence of a changeless unit-particle? If not, then one naturally asks what new properties appear when matter disappears? We must then inquire what essence composes this unit of matter which is prior in importance and permanency to physical reality?

The hydrogen atom, moving with various speeds in various structural formations, represents to us the various frequency-sensations that are encountered in lead, iron, mercury, water, and helium gas. But what is the basic unit of matter which, when structurally organized through time in dependable form, now appears to us perhaps as the hydrogen atom, and which in another state may be discovered as a still smaller bit? May not this tiniest of all particles, the ultimate building-block, when it is itself decomposed, furnish us with quite a new, even a non-material principle? May not such a disintegration provide us with the second element of the dualism?

First there is matter in unit or multiple formation, and then there is something else, something which is not matter, but which appears out of matter, and which has no physical properties. The unit of matter may be millions of times more solid and rigid than the composite structure known as a piece of radium, its tiny structure may resist far more disruptive force than any large composite atom, but it is not to be forever permanent! This is our postulate.

In defining matter let us now take a novel viewpoint. Living as we do in the presence of unceasing change, let us postulate that even matter is changeable—that no one piece of matter will be forever permanent. After doing this, we may reason about that into which it is changed. We now require two definitions instead of one. The dualism is now facing us, and we may even have the joy of glimpsing the important process by which this dualism is resolved into a unity.

Let us believe then that the matter-principle may be done away with; that the smallest bit may become less than the physical unit; and that the resulting essence will be non-material. We must then conclude that the definition of that new something which matter becomes, will lack the defining properties of matter. It will no longer possess rigid inertia

and occupy space. This is the important principle suggested and seemingly confirmed by experience.

Let us now leave this brief consideration of the process of change in which matter with its inertia may altogether vanish, and lay greater emphasis on the properties of matter so long as it remains physical.

Because the usual gross displays of mechanical energies are received and sensed solely as the additions of the blows of many single unit-particles, we may, from our mechanical standpoint, call the smallest bit of matter either the unit of mass or of momentum. Momentum is never present unless the unit-particle has struck other matter, and matter never strikes another body without delivering momentum. Nevertheless, *matter and its "charge" of motion are different realities.* This truth must be emphasized. We may be unable to separate mass from its momentum in the physical sensations derived from repeated contacts with separately imperceptible bits of moving matter, but this gives us no right to assert that the unit of mass and the unit of energy are the same. Every rain-drop is round and wet, but roundness and wetness are not the same things as water-particles.

If any bit of matter is so tightly bound up in itself that it never expresses any of its internal powers in space outside of its own volume, if it never separates parts from itself, never sends out physical messengers from that space which it exclusively occupies; if it always moves and acts as a dependable physical whole confined to a definite extension; if it allows no other force to reduce or expand the volume which it claims; and if it transmits other energies without elastic compression; then this space-occupying body has all the attributes of the unit of matter, and, when in motion, delivers the unit of momentum. Mass and momentum are not identical to reason, but, in the unit form, they are at least indistinguishable to our particular capacity of receiving appreciable sensations.

Further discussion of the nature of the unit of mechanical solidity and inertia would appear futile, for the inner being of this solid and changeless unit can perhaps never be known by direct experience with it as such. To be sure,

its inner constitution may perhaps be apprehended by reason, but only because at times some of these solid units are torn asunder and reveal their inner and immaterial essence in that which is then delivered to mental realms.[1]

A lead bullet may be composed of nothing more tangible than its electrons which make up its atomic parts; there may be immense empty spaces between the separate electrons; the electrons may occupy but a very small portion of the total volume of the bullet; the electrons may themselves be regarded as volumes of energy or of mass; the electrons may be composites; yet, however this may be, so long as this lead ball remains for all practical purposes an inelastic and immutable whole in all of its actions and reactions with surrounding matter, it may be regarded from the view of the usual perception as a unit either of mass or of inertia.

Of course no ball of lead ever remains long in this changeless state. Heat is being added or subtracted; gravitation is working; light is impinging and reflecting; the air is pressing; the internal parts are vibrating; and, as time passes, it is being changed in many ways. For a few seconds, if perfect exactness of measurement is unessential, we may make use of the lead ball as a changless unit, but, for a permanency, we must conceive of something which, so long as it remains matter, is really changeless. For enduring calculations one must consider the smallest material corpuscle, whatever it may be; and we must regard it as a unit which (so long as it *is* matter) may never be compressed, divided, nor in any way altered by the blows of other matter. It must be a particle which has no pores into which other masses may creep, and which, if the action of other masses or particles ever divide it, will become so different from matter that it will no longer correspond to our definition of inert, unemotional substance. A larger body—an aggregation of many unit-particles—for all usual purposes and conditions may be the practical unit of the moment, the month, or the human life-time, but this is true only because it is

[1] The reader will notice that I have used the word "momentum" in the preceding paragraphs where the word "energy" would ordinarily be used. The reason for this will appear in chapter XXI.

composed of particles all of which are relatively changeless for this interval.

We have only recently become aware of those almost incredibly small particles known as electrons, and this acquaintance has already made us view electricity as the effect of the blows of electronic masses. Electricity is the name given to the momentum of a certain type of series of blows from that unit of mass known as the electron when moving at a certain speed. Now that man has discovered these exceedingly small bits of matter, some scientists are inclined to suppose—rather rashly, it would seem—that the electron is the unit of mass; or, more rashly still, they conceive that there are two ultimate units, of which the electron is one. Mr. Bertrand Russell, in the first part of his book, *The A B C of Atoms,* writes in qualified terms as follows:

> With electrons and hydrogen nuclei, so far as our present knowledge extends, the possibility of dividing up matter into bits comes to an end. No reason exists for supposing that these themselves have a structure, and are composed of still smaller bits. We do not know, of course, that reasons may not be found later for subdividing electrons and hydrogen nuclei; we only know that so far nothing prevents us from treating them as ultimate.[1]

But later he remarks more positively, that the electrons—

> are the ultimate constituents of negative electricity, and one of the two kinds of ultimate constituents of matter.[2]

That the electron cannot be disintegrated I shall be inclined to question later, for until all mechanical phenomena are interpreted in terms of a universal principle, I think we should first question our knowledge of the ultimate composition of matter, and, secondly, we should suppose that mechanical effects might be obtained from masses even smaller than those now realized. Certainly, the phenomena of light, heat, magnetism, cohesion, gravitation, and the quanta-radiations of energy, have not been explained as the

[1] Bertrand Russell: *The A B C of Atoms,* p. 2.
[2] *Ibid.,* p. 26.

effects of the motion of electrons or of hydrogen-nuclei. Indeed, in endeavoring to explain these phenomena, physicists, attempting to use these rather clumsy masses as their units, have been driven to imaginary hypotheses lying outside the principle of momentum, and reaching further than the definition of matter as inert and solid substance will support. And there still remain mysteries which these new doctrines do not solve; and other facts which even seem to contradict them.

Many different sensational effects may be experienced through the single principle of mass-momentum if and as the accompanying conditions of velocity and frequency are varied. The possibility of change, either in the velocity or frequency of the blows received from material bits being almost limitless, the characters of the resulting phenomena, as displayed in terms of a series of blows, may be almost myriad. Hence, if a phenomenon like electricity seemed in the beginning, before the electron had been identified, to be outside the ordinary principle of the momentum of moving matter, we should have been inclined to infer, I think, that it did not represent a new happening unrelated to the definition of the inner being of matter; but rather that something pertaining to the conditions had varied to give this unusual result. The frequency or velocity of the blows might have been unique, or the electric effect might be due to a new structural arrangement of the striking objects—a new quality, which itself, however, finally depends upon the velocity and frequency of the unit-blows.

Nature would seem more harmonious if we could explain all mechanical phenomena according to some one principle —a rule of procedure for the unit-mass which is unchanged for aggregations of it except as the effect may be altered by changes in the rhythm or regularity of the series of repeated unit-effects in space and time. Mere multiplication of numbers hardly affords a new basis of principle. All mechanical effects—except those incidentally due to the symbolic character of the repeated and rhythmic vibrations—should be related to the attributes possessed by the smallest bit of matter—and as possessed *within it.* I have already defined

these attributes as the willingness to move when struck, and the unwillingness to share space with other particles. These quality-principles are simple, definite, and understandable. Perhaps it is only because the motions and arrangements of particles are subject to such an infinite number of combinations that we sometimes find difficulty in explaining all energetic effects as due to the blows of these tiny matter-bodies. It should satisfy our sense of fitness, however, if we could refer all mechanical energy-manifestations to the principle of momentum, delivered singly or in a series. Attempting this, we might discover that perplexing results have sometimes appeared, not from the presence of a law of nature hitherto unrelated to inert matter as we have defined it, not from a new kind of matter or energy, but rather because effects are being produced by the actions of masses invisibly small, or moving with unexpected velocities, or in unique series.

A force acting at a distance, for example, such as gravitation is supposed to be, a pulling that occurs without mechanical attachments to pull by, is a force entirely distinct from the effect of the blow of matter. It has no relationship with inert solidity, and with the unwillingness of one matter-particle to share its space with another. There is no known source for the power which is expended; and yet the power is supposed to stretch itself out in infinite fashion into an infinite emptiness where no matter exists, and where there is no physical universe. For this reason, gravitational "attraction" is unreal; and was inconceivable even to Newton. Nor does it subscribe to the Conservation doctrine. Let us attempt, then, to explain this phenomenon otherwise.

Let us not bring new principles into this universe of ours —into the relations between worlds, or within the atom— until we have exhausted the possibilities of the old definitions when conjoined in thought with the presence of smaller units than formerly conceived, and of new conditions pertaining to them. Let us not complicate our problem by supposing that there are types of energy different from that which we naturally expect from the blow of solid space-absorbing matter-bodies as defined.

I cannot conceive that the matter-particle might manifest energy which does not depend upon the presence and use of the characters *within its volume.* Its internal qualities, its solidity and inertia, seem to be the only conceivable properties which it can make use of. I cannot understand how any part of a material corpuscle can exert influences in places where no part of itself is. Force exerted outside of a matter-body is certainly not a force *of* the matter-body. The ability to express force outside of itself, even throughout infinite space, is an inconceivable attribute of a normally inactive unit of solidity. For mechanical energy to be manifested in a conceivable fashion, the blow of the unit of matter *must be delivered through the use of quality-principles pertaining to its own self*—not through imagined imponderable offshoots from its own volume extending magically everywhere.

Magnetic and electric "attraction" and gravitational forces (before the Einstein theory) were supposed to be derived without the use of unit particles as blow-givers, and without the expression of some force-principle residing within the matter-body. Yet the attraction of the sun for the earth, as this attraction exists here *at the earth,* cannot at that time be regarded as existing within, belonging to, and as being part of, and a character of, the sun. Just this unreality, nevertheless, has been embodied in the theory of attraction.

Not the result of the blows of solid particles, not the momentum expressed because the rigid unit resists subdivision and moves along before another striking particle which must either move or divide it, but a mysterious force acting through and by means of empty space, pulling substance to substance without physical hooks and ropes to pull by, exerting energy without mechanical connections whatsoever,—and without source of power which is being drained by the use,—operating solely with nothingness as a fulcrum and lever, and as a blow-giver to cause motion, a force living *there* while it acts *here* millions of miles away, a force which is supposed to extend from the smallest piece of matter with infinite potentiality to attract matter wherever it may be shielded,—this is the unexplained, unreal, complicating, inconsistent,—yes, even incredible and unnecessary,—hypoth-

esis that has been developed in the imagination to explain experiences. Yet these events, mysterious as thus explained, may have occurred in perfect consistency with a simpler conception.

I shall now deviate a moment to illustrate the difficulties of the physicists as with their different theories they view the phenomenon of light. Having conceived light, not as a movement of unit-matter in some series or grouping, but as a wave of energy translated through a space empty of matter, they found it necessary to invent a new kind of filler to occupy empty space and to act as a medium for carrying this wave-motion. It was named ether, and has none of the properties which matter, by its definition, should enjoy. Scientists could perhaps imagine gravitational "attraction" as coming from sun to earth without an intervening medium, —without physical chain of communication of any sort,— but they could not believe that energetic wave-vibrations starting from the sun could occur in emptiness, or that they could be delivered with energetic effect to the earth at the end of their journey by this nothingness. Being convinced, nevertheless, that light was manifested as a wave-force, and that it was not the result of a repeated momentum-chain reaching from sun to earth, they invented an ether to vibrate, and to carry the imponderable wave-oscillations. The scientists have imagined not only extraordinary kinds of energy, but extraordinary kinds of matter. Such are the necessities when the premise—the basic definition of what takes place —is not truly founded.

The assumption that the mechanical energy of light may be displayed by the means of such an immaterial and intangible substance as ether,—or by transmitted strains through electromagnetic "lines of force," as they are called —or that a mechanical energy like gravitation might be displayed by a matter-body in space external to itself, and therefore without the use of any principle then dwelling within it, seem unreal. In later chapters, I shall offer explanations for both the transmission of light and the phenomena now supposed to be due to gravitation. These explanations will be founded on the momenta of mass. Here the emphasis is

to be placed upon the definition of matter. I have set forth what I think the unit of matter is, and I have intimated that it possesses no mysterious ability to create motion exterior to its own being. It cannot "attract" another body towards it from a distance. It has no such prerogative. It cannot "pull" things. A credible world must be explained on some other hypothesis.

I am unable to perceive, moreover, that matter possesses volition, and thus I cannot conceive how it would create motion in exterior bodies even if it could be attributed with the latent ability to do so. A thing as dead mentally as a stone, as insensitive to emotion, plan, or purpose, with no evident will—why or how should it reach out and use nothingness to pull another stone towards itself? Even man with a perceptible mental force and will has no such ability. No; the principal character of matter seems to be steadfast possession of a constant amount of space. It thus displays characteristically the deadness of passive inertia; whereas the ability to cause motion seems to be possessed typically by the highly developed mental part of the dualistic universe.

The power of moving substance, indeed, seems to be the prime function of the mental principle—at least in so far as it treats with the physical world. This ability distinguishes the positive vital principle from the negative deadness of inertia. Matter, the "thing-in-itself," while it is itself, must be explained, not as if more alive than man in its ability to express force outside of itself, but rather as almost wholly inert and self-contained. The mind-power, in turn, is not *slightly* inert and *somewhat* ponderable, but rather, in its purest state, is entirely active and completely imponderable. To maintain this distinction it is necessary to explain all seeming "attractions" as disguised examples of momenta. I am hopeful that this can be done. And as to our mind-power, or life-principle, we need not discuss it except in its relationship with matter. We need define it no more exhaustively here than to say that it is the power which can and does make matter move with purpose. With these definitions and distinctions understood, we can continue with the argument.

CHAPTER VI

MIND IS MORE THAN A MECHANICAL REFLEX

> And those, indeed, who alone admit bodies to be beings, and who contend that essence is in these, say that there is one matter which is spread under the elements, and that it is essence; but all other things are, as it were, the passions of matter, and are matter subsisting in a certain way, and thus also are the elements.
>
> PLOTINUS

A PHILOSOPHICAL discussion almost inevitably reaches the puzzling abstractions, Space and Time, for mechanical experiences have been formulated mentally (and also in physics) principally in terms of them. It is well for us to approach these matters gradually, if deliberately. This chapter will deal chiefly with the distinction between mind and matter, but the relationships of Space and Time with mind and matter will also be introduced.

Modern theory rather takes the view that matter is simply a form of electro-mechanical energy; but, since electric energy displays both mass and inertia this concept does not invalidate the definition of matter given in the last chapter, and does not affect our idea of what the essential matter-property is. Even if all matter were composed of electrons, what then? In unit form mechanical energy and the substance which displays it are never to be distinguished empirically. And yet, as all know, energy must be added to matter before it is possessed by matter. If the smallest bit of matter were the electron (though there are reasons for believing otherwise), all energy would result from the blows of electrons, but this would not signify that all energy may properly be described as "electric" or pertaining to electricity. Electricity is the set of properties exhibited by electrons when moving in a certain way, in a certain series, in a certain direction, and at

a speed of about 186,000 miles a second. The blow of electrons composing a cannonball is never called electric energy.

"Electromagnetic" energy, however, is the effect given by the unbalanced collisions of electrons when moving at their normal un-grouped velocity through inter-atomic space. Certainly, if the smallest bit of matter were the electron, then all appreciable momenta (and kinetic energies) are composed of the multiple blows of this tiniest corpuscle. Even so, however, it is not to be denied that the impulses of different series of the smallest particle with different velocities can and do give us different sensations. To only one of these do we give the name "electricity." The others may be perceived as light, sound, heat, or the blow of a bullet.

If an electromagnetic "field" pervades the spaces between worlds, as the theory of Faraday postulates, this may mean nothing except that myriads of these tiny particles, either singly or in semi-permanent groups, are passing through this inter-world volume at high speed. We are quite willing to call this an "electromagnetic field," and even to dispense with the ether-theory in favor of this "field." Faraday believed that unbalanced mechanical phenomena took place in this "field" because of lines of "strain" in it—and not from forces acting (instantly) at a distance. We are postulating that there may be such a field of matter composed of particles whose energies of motion may or may not evidence "strain," or temporary lack of energy-balance.

Indeed, the idea of an electromagnetic "field" as a place where electrons (or perhaps groupings of tinier particles) are usually to be found moving, carries with it important suggestions. The moving particles in this field doubtless deliver momentum of the usual type, and hence they will move out of the field altogether unless resisted by equal pressures (or blows) from "fields" alongside. Bits of matter must move everywhere within the universe, then, even in those free spaces where, according to conventional belief, matter is not supposed to be. Except for these general movements, there would be more energy-delivery from some volumes than others, and an adjustment of matter would necessarily follow.

The electromagnetic theory seems to inform us that there is no wide extent of unoccupied, empty space; but that even between worlds the invisible particles move with those enormous velocities that are required there to maintain the energy-equilibrium of the universe. Here I speak for the first time of a universal "energy-equilibrium", a concept which is important only if the universe is finite, for no concepts of associated energy-relations are necessarily valid in an infinite universe, whereas in every finite pool within which motions are restrained, and wherein the particles move constantly into contacts with one another, the energy-expression throughout the volume must, in the average, be approximately uniform, and the relationships in the average must be predictable and dependable. Thus, we cannot conceive of an undisturbed pool of water in which the pressures long remain greater in one part. A "field" of more than average pressure on each square inch of its surface will quickly develop movement into another field of less pressure, and an equilibrium will soon be established by this movement.

A second thought follows: In order to maintain the energy-equilibrium, the velocities must be greater in the more diffuse volumes. Densities may vary, but the energy-expression tends to uniformity. Or we may say that up to certain limits the velocities will increase in some inverse ratio to density. In the open spaces, near our earth at least, the particles move at a certain characteristic velocity. When this same particle is found in the denser structures of our elements, its motion will be comparatively slow. The impression produced by the blow of a composite grouping, a cannonball or what not, however, relates, not to relatively great internal speed of any one of its particles, as moving back and forth within the composite, but to the velocity of the grouping as a whole.

What then is the electromagnetic field? Apparently it is a volume wherein electrons are separated from atomic structures and are moving at characteristic speeds. It is an electron-field. Are all electron-fields the same as electromagnetic fields? No! The cannonball is an electron-field, but not an electromagnetic field. Furthermore, every space

between worlds, even if full of flying particles, is not necessarily an electromagnetic field. An electromagnetic field is that particular kind of electron-field wherein the blows are given at approximately the speed of electricity, and wherein the energies of motion, at the time, are not balanced from and in all directions. In a true electromagnetic field, the universal harmony of the normal energy-equilibrium has been temporarily disturbed, and is in the process of being restored. Thus, in one sense, the energy-movements are in a "strain." In such a field, an intruded body will receive more blows of free electrons (more of the unbalanced electric effect) from one direction than another.

This description of the balanced, or potential, electromagnetic field in the inter-atomic spaces is suggested by the hypothesis that a general mass-energy-field pervades all space—not as a continuum, but as an averaged state of affairs. To obtain the active electromagnetic field from the normal state of balanced averages of energy-expression, we must introduce the additional thought that this field of normally balanced energy-movements is often affected by a significant Change, or Involution. This phenomenon unbalances the otherwise normal state of energy-balance. Or, the balance may be disturbed by the act of any life-form. Because there is sometimes a state of unbalance in this energy-field, its corpuscles will then deliver energy more in one direction than another. This gives rise to the idea of an unbalanced energy-volume, or "field" of force.

We shall in later chapters discuss these principles more fully. The development of these ideas will permit us even to dispense with belief in an ether-substance continuously filling empty space. Nor shall we require inconceivable definitions of matter and its energy in order to define everyday phenomena. The electromagnetic theory does not incline us to alter our definition of the unit of matter. Rather, it confirms some of our other beliefs, none of which is more important than the postulate that oscillating particles of matter may be found all the way to the bounds of a limited physical universe.

The conventional theory more or less assumes that elec-

trons carry a "field" of energy about with them; but we find it unnecessary to adopt this view. We cannot imagine a "field" of energy that is not a "field" of moving matter. We believe that all mechanical energy comes from the blow of matter and that the matter-body then is at the place *where* the energy is being manifested. We have confidence in our definition of matter. Of course, any composite body may be in a state of internal unbalance. It may be shedding radioactively a mist of its tiny constituent parts, and thus may be displaying that, which, for the moment, represents a volume of unbalanced energy. We can comprehend such a "field" of unbalanced force, for it accords with our definitions, and we are willing that it should be called an electromagnetic "field"; but we do not think that such a composite body, whether the size of an atom or whether it includes the whole universe of matter, or any of its material parts, ever expresses volition or free-will, or ever attracts or repulses at a distance, or ever exercises energy by means of, or in, empty space.

We must take a definite stand; we must admit some distinction between the living and the dead; and we must define mechanical energy as one thing and not as two or more. We have here divided the universe into a dualism of fairly distinctive quality-characters, the separating definitions of which seem to be apparent. Unless two orders existed through long periods of time with these distinguishing differences, with contrasting definitions, and furthermore, with possibilities of "absolute" change from one class to the other by rearrangement, there would be no important phenomena due to motion, there would be no cause for motion, and, finally, there would be no evolving existences such as are mentally and physically experienced.

Both matter and mind, it would seem, are composed of one essence; but one is passive and the other is distinguished by its natural activity. Life is perhaps to be viewed as a process of evolutionary re-arrangement, a process devised and carried on by a mental power external to matter. Evolutionary change is derived from the readjustments of the arrangement known as matter. As a final development of

this process, the physical arrangement is slowly being decomposed, and the released essence is realized as mind-power. The continuing Evolution, both in matter and mind-power, reaching back as they do as far as history and geology can determine, tend to make us accept this dualism of arrangement, and also the fact that there is a created change from one state to another.

Our analysis having brought us thus far, and having supplied us with our definitions, we must attempt now, if possible, to harmonize our theory with our experiences *with* the universe.

Obviously, we do not believe that mental acts are physical reflexes; but rather think there is a vivid distinction between the arrangement which displays inertia and that which overcomes inertia. The spiritual character seems to renounce extension entirely. Apparently it is distinguished by its invisibility, its imponderable activity, and by its power to make matter move with a purpose. Dead matter, on the other hand, until "charged" with motion by a spiritual force, expresses appreciably only inertia, internal rigidity, inelasticity, and extension. If definitions distinguishing the inorganic from the organic more exactly (or differently) may be offered, let some one offer them, and then let him build his corresponding theory, and consider whether, as thus explained, the experiences of life are more or less reasonable.

To be sure, after the motion of matter is started many events follow in an automatic mechanical sequence. Relatively few events in our lives have a direct primary mental cause. And many activities which seem to be mentally derived, really spring from a preceding cause that is a part of such an automatic mechanical chain. Even though an act is mentally directed it may end with nothing accomplished more than the mechanical restoration of a physical equilibrium previously destroyed. This last is a particularly important point, for we are apt to be deceived philosophically by a mechanically perfect outcome that is mentally caused, and may then be inclined to assert incorrectly that it, too, is derived from an automatic mechanical sequence.

A carrier-pigeon seems to find its way home by instinct—

an attribute often defined as an inherited power to act in a certain way in a situation in which the knowledge gained from a recent experience plays no part. One person may claim that this so-called "instinctive" ability to return home is a mental inheritance of the pigeon, that thought itself is inherited in the body and remains there like electricity in a storage battery, whereas another will assert that instinct has a direct physiological derivation, that it and all other mental attributes are derived from a physical sensitiveness in some part of the body, and that there are no such things as instinct and mind-power as distinct from physical forces. We cannot agree with either conclusion. The temporary lack of body-equilibrium might serve as a cause to *influence the judgment* of the homing pigeon (as it exercises choice) to take the body back to the place wherein it had previously experienced a more balanced satisfaction. The so-called instinct of the carrier-pigeon might also have a physical origin. A rubber ball, after being mashed out of shape, tends from purely physical, rather than mental reasons, to regain its balance with the surrounding pressures by returning to its normal contour. This, however, is not at all the case of the pigeon.

The beginning of many subconscious and conscious acts, if closely analyzed, may signify nothing more than the attempt of *the mental power within the organism to restore the physical equilibrium of the body.* A condition of mechanical unbalance may seem to be the direct cause of many activities which end in the restoration of complete body-equilibrium; but, even if the mechanical series seems to be perfect in a mechanical sense, the cause of the mechanical balance of this particular kind may not be *mechanically* grounded. Even if there were a condition of physical lack of balance of a certain kind, unless a mental power was present there might not be any mechanical movement whatever, and certainly this particular type of movement would not take place unless the state of physical affairs acted as a *mental* incentive to this *particular* act of restoration. An unbalanced physical situation of a certain kind may often stimulate the mind into a certain type of activity that would not take

place were only dead matter present. In such cases, however, it cannot be said that the activity is mechanically caused, or even that it is perfectly in accord with mechanical necessity.

When we refer to a mashed rubber ball, its entire tendency to return to its balanced shape—and the mechanical motion as well—seem to be nothing more than a phase of that certain aspect of mechanical routine which calls for a universal equilibrium of mechanical energy-expression. Certainly, in the case of the ball there is no appreciable mental stimulation or directive thought—at least none behind the local act. Nothing in the local act expresses imagination or volition. On the contrary, all of it, when viewed within certain bounds, is typically mechanical. Why, then, should not another state of physical unbalance affect, influence, and even cause the activities of the carrier-pigeon?

Physical movements can certainly reach and influence through their presence the mental judgments of life-forms; but, in the case of the carrier-pigeon, the effect, as represented both by the conditions of the flight and the *choice of the direction of the flight, is not a perfect mechanical equivalent of the state of physical unbalance.* Not the mechanical maladjustment, as such, for in some respects there is no maladjustment, but the *mental appreciation of the condition of an unbalance* affecting this life-form and recognized through the mental appreciation of the effect of a past happening, is to be regarded as the cause of the *particular type* of motion that results. The mind of the pigeon may release stored-up physical forces sufficient to furnish most or all of the power of the motion, and no physical force may be expressed except what is represented in the potential energy released from the food which the pigeon has consumed; but the power which *releases* the energy for this particular activity, and especially that which *directs* the flight, is not mechanical in type, but is mental, purposeful, and selective.

Every physical blow of sound, light, taste, touch, or smell, whatever it may be, leaves its impression within the struck body, and to this extent destroys the former body-equilib-

rium. After the receipt of an unusual blow, the state of physical unbalance as thus created is then naturally taken as a guide by the mental power directing restoration. As Descartes said, "the body is utilised for the ends of the mind," and also the "signs" of the body are utilised to guide the mind.

In all living organisms departures from a state of physical satisfaction may *guide* the emotions, instincts, and the conscious reason, but nothing influences the rubber ball but the already moving and therefore already directed and conditioned physical energies of the environment at that particular moment. If a mental power lives within the ball, it does not, so far as we can judge, direct its course in independent mental fashion. Matter remains inert, and, seemingly without will or volition, submits to every mechanical action. It merely responds moment to moment to the passive "necessity," so far as it is concerned, of being in perfect mechanical equilibrium with surrounding forces, and to the further necessity of responding perfectly to all the mechanical conditions displayed by unbalanced physical forces.

In the case of the living organism, a mental power with will and volition to some extent is able to select and direct the mechanical act that *is to follow* a certain physical change. It also determines that a certain activity shall take place *now* rather than later, and *this way* rather than that. Mental power is used, too, to release the action at the particular time purposefully advantageous to the particular organism, and as selected in advance. In a higher form, the mental power might even supply most of the motive power.

It is different with matter. Like an automaton, like something possessing neither volition nor will, inert matter moves exactly to the extent and in the direction that it must move in response to mechanical forces of the environment as then affecting it. The ball of our experiment acts exactly as every similar ball will act under like circumstances. There is no choice here, no mental purpose displayed, no selection of time, place, or direction. The ball cannot regain its spherical shape until the mashing pressure ceases; and, after the release of distorting pressure, only one result is possible—

unless, perhaps, the mental will of some life-form intervenes and exercises a volition which is independent of the universal mechanical routine. The reaction of the ball itself is received completely from the external mechanical forces as then being expressed. Almost all of these activities in inorganic realms which we recognize, seem to us to have direct external physical sources of power. This principle is not true of the living organism. On the contrary, it may be asserted that even in its release of physical power the mental force displays some of its own inherent command over matter. We are as yet but slightly mental, but we are partly so, and the least fringe of influence of mental power which we can identify (and we have pointed to one) is sufficient demonstration that the mechanistic hypothesis is not all-embracing. Indeed, the mechanical account probably does not explain any activity exactly, whether in organic or inorganic realms.

Yes, we are but slightly endowed with freedom. Schopenhauer thought it useless for the individual will to cope with the universal will. Yet even this is not entirely a sound view. Every mind-power can accomplish something, and the least something may have important results. More can be accomplished, however, by directing universal forces than by combating them. We deliberately arrange the ferry-boat on our country streams so that without effort on our part the force of the current will carry us to the other side. We could proceed differently. We could row the boat, or we could unharness compressed steam and let this force drive the boat against the flow of the current. Certainly we can now have our way with universal forces only ineffectually, but some of this freedom is in us, nevertheless, and, faint as it is, it is a real power.

The completely mechanistic interpretations of bodily acts as held by biochemists however modern, do not alter our belief. We should estimate off-hand that many bodily activities are mechanically automatic because due to direct mechanical reflexes of a physico-chemical nature. Not quite all, however, and this "not quite" supplies the needed assurance for a vitalistic philosophy. By perceiving that the mental power as such does always have a typically unmechanical

part to play, we are able to distinguish satisfactorily between the living and the dead. Here we are able to identify a significant free-will, a mental direction of physical states.

Because of their great success in recent years in advancing physico-chemical explanations of bodily acts, many biologists are flushed with enthusiasm for their mechanistic theories. Their conclusions seem to point to pure mechanism as the ultimate explanation. Because of the trend of their statistics many assert that all bodily acts will eventually be charted according to mechanistic science. They say that no other principle exists within the living body. Thus, Professor Joseph Needham, of Cambridge University, writes: "One would have only to extrapolate the curve (the graph having as its ordinate the progress made in terms of mechanistic explanation) to find the date at which complete mechanistic explanation of bodily life should first become possible."[1] How incorrect this view is in light of modern knowledge one may gather somewhat from the quotations already given.

Let us look at this imaginary graph of the biochemist from a different view. We may then give it the reverse slope. If one had known the exact facts about bodily actions some hundred thousand years ago, and had made the beginning of a graph then, and had added the new facts that have developed every thousand years since, the graph thus constructed would, we suggest, point to the era when no mechanism will be discoverable in life. In the past we have perhaps been inclined to attribute more power to our minds than they have. This is a result of egotism. We thus started our graph with too high an ordinate on the mental side, and, as we arrive at the present day facts of physical causes within our bodies, we find our imagined high percentage of mental freedom falling to a more modest reality, but this slippage, not from fact to fact, but from dream to fact, is neither indication nor proof that the mental power of life-forms to sway matter has ever been zero, or that it will ever reach zero. From the earliest ages since man arrived on earth there has been an evolutionary progress in human mental powers,

[1] See various writers: *Science, Religion and Reality,* p. 241.

which, if continued, will make the ordinate of this graph rise higher and higher.

Dean Inge, and others pessimistic about the idea of continued growth in the mentality of man, doubt if there has been any human improvement in twenty thousand years. They even anticipate a cycle leading to retrogression and extinction. To be sure, the human graph may perhaps have flattened out, and it may subside later to the zero expressed by our extinction as living forms. In my other book I give reasons for thinking differently, but, even should this be the result, neither Evolution nor the unique reality of mental power would thereby be disproved.

Let us note that there is more than one kind of Evolution. The Evolution of which this work treats specifically is the transformation of matter into mind. We are not particularly concerned with any certain powers of mind as created in this process. We shall not attempt to determine whether they will increase or subside in the species of the earthly life-forms in which they now appear. Evolutionary transformation is just as real whether or not the created mind-power ever attains the dignity of fully directing a life-organism on this earth. It is more important that mind-powers as developed in living organisms do now somewhat create their own mechanical environment, and do express feebly—but really—a reality independent of purely mechanical principles. Mental freedom of this sort is a necessary premise if my theory is to proceed farther.

Even if mind-power should never evolve to a higher state in the sense of becoming stronger and finer in its mastery of the local physical processes, even if it should retain only its present power, there would surely be a growing power of control, and an increasing mastery over matter. Men, at least, are gaining in knowledge, and such progress has real significance in that it permits them to do more with matter, enables them more to escape from an unfavourable physical environment. The present mental power, no stronger nor weaker but with sufficient knowledge however acquired, may develop a power of control that will dispense almost completely with unusually unpleasant physical influences. And

this ability to control, weak as it now may be, must be identified, interpreted, and emphasized. It is a real control of matter by life-force.

A certain measure of control of matter by mind is implicit in life, and history proves that the range of control is increasing. As we compare ourselves with man of a very early day we cannot doubt either the fact of mental Evolution or the fact of increasing control of matter by mind. And this principle lies outside the mechanical definition. Matter-bodies appear to possess none of this ability to act independently. Certainly they cannot re-order the present so that it will become that particular type of future which conforms to a rational purpose and to a reasoned plan.

As M. Bergson says: "The mechanistic philosophy is to be taken or left; it must be left if the least grain of dust by straying from the path foreseen by mechanics, should show the slightest traces of spontaneity." In many pages of his *Creative Evolution* he argues that the evolution of the past could not have taken place, or have been guided, or driven, by a purely mechanistic power-principle. And we agree with him that "Life is, more than anything else, a tendency to act on inert matter," and that, "The direction of this action is not predetermined" (p. 96), and again, "The role of life is to insert some indetermination into matter." (p. 126)

Bergson tries to prove his case in terms of metaphysics, but such proof is not particularly acceptable to the scientist. The physicist does not usually trouble himself to follow such an argument, but is led to deny, or to ignore, the conclusion. He is apt to assert, without proof acceptable to the philosopher, that mind-action is a physical reflex conditioned upon brain-functioning. Otherwise how could the Conservation doctrine, the foundational axiom of mechanics, be valid. Yet, as Bergson points out, there is no organized brain-tissue in the unit cell. And Mr. E. B. Wilson, in *The Cell in Development and Inheritance,* states that: "The study of the cell has, on the whole, seemed to widen rather than to narrow the enormous gap that separates even the lowest forms of life from the inorganic world." (p. 330)

Professor Needham describes the mechanistic nature of bodily processes, but his thesis seems inconsistent with his own statement at the conclusion of his essay that: "Mind, therefore, and all mental processes cannot possibly receive explanation or description in physico-chemical terms, for that would amount to explaining something by an instrument itself the product of the thing explained." [1]

If the mind cannot alter bodily processes in any way, what is it, and what can it do? How can one be sure even that there is such a principle? But if the mind is anywise different in quality or power from the matter of the body, how can the difference be interpreted except as the expression of a new, and, to this extent, a non-material principle? How is matter containing mind able to act differently from an inert stone? Mind is not matter, as Professor Needham says, and cannot be explained in terms of chemistry or physics. How then can it be explained? We do not learn much about the power of mind when Professor Needham tells us that:

> The opinion, therefore, which seems to me to be most justifiable is that life in all its forms is the phenomenal disturbance created in the world of matter and energy when mind comes into it. Living matter is the outward and visible sign of the presence of mind, the splash made by the entry of mental existences into the sea of inert matter.[2]

Very good, but what "disturbance," what "splash"? If the mind in its own body-organism cannot have anything to say about bodily processes, what matter can it "disturb" and "splash"? How can it make even the tiniest ripple? Does it merely reside there, in the body, leaving matter entirely alone? If so, how do we know it is there? Does it get no sustenance from being there, no support? Does matter surrender nothing to it? Is there no reason for this relationship? Or might it be, after all, that the physical interpretation is erroneous, that the mind does act upon the body?

Many bodily changes, we admit, appear to be as mechanically subservient as those of the mashed ball, but not all

[1] *Ibid.*, p. 250.
[2] *Ibid.*, p. 251.

of them. Because we lack complete understanding of many of the mechanical alterations that bring unstable physical conditions into the harmony of our body, and because we are unacquainted with the hints given the subconscious mind by these needs of mechanical adjustments, we do not identify those activities which are urged by mental powers and those which are reflexes purely mechanical. Many actions appear to be, and are, induced in conformity with pure mechanism. They resemble the fall of a scale-beam when only one of two balanced weights is removed. Still others, while restorative in a purely mechanical sense, originate in realms beyond conscious mental ken, and many of these are doubtless due to non-material influences. Released mechanical energy, to be sure, is usually directed mentally in the interest of the physical repair of the organism (health) rather than in favour of dissolution (death). The mental steering of an organism naturally corresponds with certain of the physical necessities of life. Mental purpose is expressed in the preservation of life. However, a body containing no mind-power could not, and would not, thus act.

The mental control of physical happenings is illustrated by the fact that a body may at a certain time be in perfect physical balance and yet lack mental adjustment to the situation. Mental purpose may be looking ahead and preparing for a satisfactory future. A sprinter preparing to run crouches with hands on the ground ready for the spring forward at the crack of the pistol. His crouch, as mentally guided and created, refers to the action that *will* be necessary. The physical power within him is now released and directed to satisfy not a present but a future physical need as now mentally anticipated. When physically interpreted the situation for which the act is preparatory does not exist. The mind-character has the uniquely mental ability to anticipate. It can act now in order that something else shall be (or not be) later. It can carry out a preconceived and mentally arranged plan satisfactory for the future mechanical relationships of its own particular organism. Within the range of its limited capacities the mind of man can even make the present mental wish become a future mechanical reality.

A man can now act so as to cause a *certain one out of many possible situations to appear. And this ability to anticipate and to choose belongs solely to the mental principle.*

We have said that when a rubber ball is mashed it inevitably rounds out when released from the mashing pressure. A human counterpart, the cheek of a child, let us say, may be puffed with air, so as to act automatically like a rubber ball. In the case of the cheek, however, if the act is likely to prove painful in the future, if, for example, the point of a needle has been so placed that the flesh will be pierced when the cheek rounds out, the child's mind can plan against this painful result. Foreseeing the future mental unpleasantness of the normal physical event, the mind can forestall it—and thus prevent its being. In the present a life-organism can somewhat regulate the course of its future, whereas the rubber ball always acts mechanically. The mashed rubber ball will expand against a knife blade, even if its structure is cut to shreds thereby.

Now, obviously, the happening which the present mental act of the child prevents, did not exist and (because of this act) will never exist as a physical reality. At the time it was prevented it existed only as a mental anticipation of what *would* surely (when regarded in the light of mechanical determinism) have happened if a different principle, a mental act, had not intervened with its non-material reasoning and directive power. Only a mental power is qualified to act in this way, and this unique ability satisfactorily distinguishes the mental principle from the mechanical. A mental power, we conclude, possesses a certain freedom of action both in controlling and in directing the physical routine of its own particular environment.

If Evolution is to proceed harmoniously in the physical body of a living and changing organism, an equilibrium with the physical surroundings must be maintained. It can be maintained, however, only by the employment of directing activities of an "absolute" kind, activities such as only a mind-power, conscious or unconscious, may originate and carry out. Certain physical states, either in the body-relations of life-organisms or in the environment, may indicate,

not necessarily a lack of physical balance in general, but the physical *unfitness* for healthy life of this particular organism—an unfitness that may be appreciated and taken in hand only by a mental judgment. These physical conditions guide the mind-power of an organism in many of its specific mental decisions and undertakings, and the activity as thus guided leads to the restoration of bodily balance, whereas some other activity equally possible is avoided because it will prove destructive *to this particular* organism. The fact that the physical balance of the certain organism is thus restored, however, is no proof that mind-power is merely disguised mechanical energy.

If there is no purely mental motivation, if "absolute" mental accomplishment is impossible, if the human mind cannot be regarded as the directing *cause* of many of the motions of matter, if what we deem to be a unique power of the mind is merely a concealed physical reaction which arises at and for a particular time, and which creates a result in a particular direction and place merely because the lack of physical equilibrium (disguised to us) mechanically creates this one certain result, then all the explanations of phenomena based on the interactions of the human mind with matter are invalid. Even were this incredible thing so, however, one could not deny that a universal mind-power creates the motions of the universe.

The Cartesians refused to attribute to the human mind the ability to move matter. As Malebranche, one of the most famous of the disciples of Descartes, said: "There is nothing in the idea of finite mind which can account for its causing the motion of a body." Nevertheless, when he referred to the Divine Mind, the case was different, for he contended that it was omnipotent, and that the idea of omnipotence included the ability to move matter. Yet, how can we suppose that a human mind, if it really is entitled to the name "mind," can fail to have some of the powers, some of the omnipotence of that Divine Mind which it must, at least faintly, resemble. When a man moved his foot, the Cartesians attempted to explain this act on the ground that the Divine Mind was then, for the moment, acting through

the man. They introduced the idea of "Occasional Causes" —an occasional Divine act of intervention, as it were.

The mathematical philosopher, Leibnitz, based his theory upon the principle of Sufficient Reason, from which followed his idea of Pre-established Harmony and other mechanistic conclusions. The principle of Sufficient Reason meant to him that nothing exists which is not capable of being proved and explained *a priori.* And it signified more than this: The proof must be and, according to him, is derivable from the nature of the causes which creates the experienced facts. Something in the very nature of the causes gives them the ability to create the facts that follow. Leibnitz was unable, however, to find in mental powers any ability to produce physical effects, so he asserted that minds were incapable of producing them. It is this point of view of the mechanists that we deny. The argument for it seems incomplete, vulnerable, and easily to be proved unsound.

Probably there has been no mind more logical than that of John Stuart Mill. He usually wrote with thoroughness and clarity. Even he, however, said: "To my apprehension, a volition is not an efficient, but simply a physical cause. Our will causes our bodily actions in the same sense, and no other, in which cold causes ice, or a spark causes an explosion of gunpowder." (*A System of Logic,* p. 232)

Yet Mill did not sufficiently consider the question, and his short argument, though clearly presented in the chapter entitled *The Law of Causation,* (pp. 232–9), is not conclusive. His discussion of causation, like his treatment of mathematics, was incomplete. If he had gone further with his consideration of mathematics he would have preceived that the mathematical proof of the inverse square law of gravitation, for example, contained a measure of inaccuracy, and he would not have stated so positively that the Newtonian formula was *absolutely true.* Nor would he have admitted so unreservedly the idea of "attractions at a distance." It is surprising that he did so, for he was sceptical of a man's ability to acquire undeniable knowledge.

This question of the ability of man to acquire valid "knowledge" has here been introduced. It is a matter of

the utmost importance, but it can merely be touched upon in this work. The law of causation, mechanical or otherwise, its validity, its reality, its significance, has been the subject of discussion since the days of Protagoras. The later writers include Professors Bertrand Russell, A. N. Whitehead, and P. W. Bridgmann. While the subject must be considered to some extent in this work, we shall give the more metaphysical arguments additional consideration in a later book. We are here proceeding upon the belief that the "laws of nature," as they are called, are due to the fairly consistent motions of matter which a mental Power *causes* to move in restrained and fairly regular and symmetrical paths. We are attempting to prove this as we go along. The motion and the restraint, we think, indicate, and thus partly describe the repeated influence of a universal Power. We are satisfied that physical brain-action does not condition mind-action, as many have asserted, either here in our bodies or in the relations of the universal Power with the stars. We are testing and attempting to prove this hypothesis in this work, and while we shall attempt to confirm our view through an examination and criticism of the axioms of mechanics and mathematics, we shall be unable to present here the extensive argument and consequent proof that might be developed from a more thorough examination of the processes of reasoning and understanding. We have assumed separating definitions of mind and matter which distinguished the parts they are now playing, and, basing our argument upon our definitions and upon the Evolutionary process which connects the two arrangements constituting the dualism, we seem to be led to satisfying interpretations of events which otherwise are paradoxical.

One of the earliest thinkers, Democritus (460–360 B.C.), reduced mechanical phenomena to a single principle—motion. He did not believe that the germ of an independently directing force could be discovered in matter. And yet what tremendous power a directional control by mind may exercise! What changes may be made by the mere releasing of mechanical energy in preferred directions! Through a tiny rut made in the top of a dyke a process can be started by which a mighty

river is turned into an entirely new course. Thus, an entirely new power-expression and history can be created! Shall this history be made now, this moment, as one whimsically drives his pick—or shall it never be made? According to the mental plan matter shall now move hither rather than thither—it shall be deflected rather than go in straight lines. According to a mental decision the pendulum shall swing to and fro or shall remain still. The power to control the time, the direction, or the beginning of an activity is often, for the situation in question, the equivalent of the control of the entire result. By it, physical nature is hemmed or released, acts in one spot or another, acts in one way or another, acts now or never acts. The railroad locomotive year after year takes every curve in the journey from New York to Chicago that the mind of the engineer has planned. The mental act planned the future physical history and made it come true.

This ability to direct action, which is given solely to mental power, is sufficient to make it satisfyingly different from the matter-principle. And the mental power of man has sway in an even wider field than has perhaps been imagined. It can participate in the general control of matter. Man can now make his will felt so as to cause a result different from what it would have been if left solely to the universal power. The sovereign power is interested in the building of his palace, but apparently he is not concerned whether his subjects place this or that brick here or there. These subjects, children as compared with him, are nevertheless like him in kind. They do not have his extended vision, nor his wide range of activity, yet they have mind, will, imagination, and purpose. It may even please the sovereign to watch his subjects making independent use of their own wills, provided only that their doings do not interfere too much with his general plan.

M. Henri Bergson suggests that mind-power, or the vital principle, is both the essence of matter and the driving force which makes matter move when he says: "We should then be dupes of an illusion like that of Spencer, who believes that the intellect is sufficiently explained as the impression left on

us by the general characters of matter; as if the order inherent in matter were not intelligence itself!" William James thought that "the visible world is part of a more spiritual universe from which it draws its chief significance." And Thomas Huxley said:

> But when the Materialists stray beyond the borders of their path and begin to talk about there being nothing else in the universe but Matter and Force and Necessary Laws, and all the rest of *their* "grenadiers," I decline to follow them. . . . "Matter" and "Force" are, as far as we can know, mere names for certain forms of consciousness. "Necessary" means that of which we cannot conceive the contrary. "Law" means rule which we have always found to hold good, and which we expect always will hold good. Thus it is an indisputable truth that what we call the material world is only known to us under the forms of the ideal world; and, as Descartes tells us, our knowledge of the soul is more intimate and certain than our knowledge of the body.[1]

Many eminent writers support these statements. Count Herman Keyserling, however, makes the different suggestion that material nature radiates a psychic atmosphere. After meditating about the extraordinary psychical influence that pervades India, particularly in the holy region through which the Ganges flows, and the brooding spirituality of the City of Benares, he remarks:

> What is the explanation of this "psychic atmosphere," which is manifestly real in the objective sense, and whose existence I feel more clearly the longer I live? I do not know. I assume that it is a question of waves belonging to an "ether" which hardly corresponds to that of the physicist, but which are nevertheless vibrations of a material kind. No doubt thoughts are just as much "things" as the objects of the external world, no less real and probably more enduring than we suppose. The spirit of an age is an entity no less objective than the physical air. If mental images were not material, they could not be infectious. I do not know, either, how

[1] Thomas H. Huxley: Essays, *Method and Results, Descartes' Discourse on Method,* p. 193.

> else I could sense a psychic atmosphere directly, how else I could be influenced so strongly by the place in which I happen to be, and be affected differently in accordance with the beings who constantly live, or have lived, there. Only he can doubt the reality of psychic atmosphere whose senses are too blunt to feel it. Its theory has never yet been written down. [1]

It may well be that a tempered physical environment, an atmospheric haze, a hot sunshine, a regular and easy food-supply, may combine to produce a mental languor and feeling of security that may greatly affect the mental character-expression of the individual. In such situation, the mind need hardly bestir itself to adjust its body, because here Nature proceeds calmly and without abrupt fluctuations. If this be so, then the physical environment may, in one sense (negatively) influence the mind, just as the mental may influence the physical. Mind and matter are not separate and distinct so long as both are parts of our lives. They are more like two weights which balance life's beam to the approximate level. In our partly physical and partly mental existence, each, in one sense, influences the expressions of the other; but their characters are nevertheless independent. They subscribe to separating definitions. Only one of them is passive, and only one appreciably originates motion.

Through observation of unbalanced pathological cases, where we discover that the conscious or subconscious mind does not direct the activities of the person so as to achieve the greatest possible harmony with his environment, we perceive that, whereas the mind-power may usually restore the physical equilibrium of its body in harmonious fashion, it does not always do so. Let us consider this matter further for it affords distinct proof of the point we are trying to make.

In the case of a neurotic person the physical signals often do not indicate the true need of physical restoration, and the independent mind tends, therefore, to over-or-under-activate the body. If all actions were purely mechanical, this could not be so. In the neurotic, the mentally directed ac-

[1] Count Herman Keyserling: *Travel Diary of a Philosopher,* pp. 222–3, Vol. I.

tivity does not bring about that reflex which corresponds *exactly* with the physical cause. Perfect physical restoration,—or, at least, restoration in that direction most conducive to the balanced equilibrium of the particular organism,—is not assured, for the reflex action may be inadequate. The mental power that directs the action may have misjudged the situation. It may then fail to supply the exact type of impulse at the right time and in the right place needed to perfect the physical restoration. The mental power may even act in direct opposition to the physical signal. It often accomplishes its own independent will—even *at the expense* of body-harmony.

By suggestion one may give the conscious mind the proper understanding of the cause of the over-or-under-restoration. The conscious mind of the doctor attempts to inform the subconscious mind of the neurotic of certain of its errors in mental control. If this can be done, the subconscious mind of the patient will direct the physical restorations more appropriately. The subconscious mind may be taught the wisdom of interpreting mentally an extreme signal as an indication of less extreme physical needs in this direction, and thus it will be enabled to obtain a better adjustment of the body with its surroundings.

When one is hungry the mind is conscious of internal pangs. Reason then interprets the mechanical activities of hunger as indications that if the body-organism is to function more food must be obtained. Hence the mind prescribes to the body those certain activities that replenish its food-supply. Except for this mental character in man, with its judgments, its will, and its powers, there would be no interpretation of the physical signal of hunger, and no appropriate action for renewing the energies of the body. That is to say, without the characteristic attributes and powers of mind, the body would be inert and dead, and subject to every destructive mechanical influence of the environment.

A man learns from the thermometer in the house that more coal should be put on the fire. Both the thermometer and the hunger squirmings indicate to conscious human thought that there is then a lack of healthful balance in the

physical environment of the body, and that certain acts of physical restoration must be originated if this organism is to persist in health in the midst of these generally destructive influences. The mind then realizes that it must perfect a new type of physical cycle, or, at least, must re-create the one that has been broken. It must at that time release mechanical energy in a *certain direction.* The mind then takes independent action, and creates a mechanical activity which, except for the reality of mental power, would not be, and yet one which most likely will balance closely the earlier motion that has destroyed the particular harmony with which this mind is particularly concerned. Only thus may bodies be maintained in a suitably balanced relationship with the normal environment. Only thus may a life exist as it does. Yet we cannot assume even that the restoration as created by the mental power compensates *perfectly* the past physical change. On the contrary, if action and reaction did exactly balance, how could there be growth followed by decay, youth followed by old age? The life-cycle itself proves that organic forms are not mechanically founded.

A man stokes his furnace because of the warnings of the thermometer. His physical activities depend upon his mental reception and interpretations of these warnings. He conventionally acts in some sort of proportion to the mechanical signal. He accepts the lower mercury column as an indication that some mechanical adjustment must be made if his body is to remain warm and healthfully balanced with the required average temperature; and the series of mechanical actions and reactions usually ends in the accomplishment of a certain mechanical result. This particular conclusion is not inevitable. Indeed it need never have been, for only the sufficient powers of the mind have caused this result. We clearly perceive that this is true; yet we realize that if a mind were so trained by habit as to accept the temperature-reading as a guide to its sensible activities it might respond so faithfully to the mercury changes that an animal, noting that coal was placed on the fire with every fall of the mercury column, might believe that the cause of the stoking was the physical drop in the mercury. Yet the stoking of the furnace stands for

purposeful directive movement. This particular activity represents a direct overruling of the one mechanical situation open to an activity corresponding with pure mechanical Conservation. It is derived exclusively from a mental principle. Except for the presence and quality of a mind-power it would not have been. The mental purpose is here directed to restore one certain type of mechanical equilibrium, one that would not have been created on a basis of pure mechanism, and this fact gives us no right to suppose, either that the purposed act is merely a response to a physical signal, or that the act of directive mind-power is in every respect the equivalent of that which would have followed from strictly mechanical principles.

Some persons contend, however, that the fall of the mercury virtually pulls a cocked trigger controlling accumulated physical power, and that this trigger, on its release, automatically strikes with a mechanical result inevitable in time, power, direction, place, and in every other respect. They assert not only that every human act consumes altogether stored mechanical energy, but that every act is completely governed by mechanical necessity. They say that mentality is not an independently directing ingredient in the universe; that it does not represent a force which might plan, regulate, direct, and even alter pure mechanical routine—even temporarily. They believe that no force can accomplish its purpose in such fashion that the total active (or potential) motion of matter may be increased or decreased, or ever deviated from those paths subscribing to the Conservation principle, or postponed in effect even for a moment. Every human activity represents to them the automatic release that could occur only along this particular path, at this particular time, and for this one mechanical accomplishment.

According to this hypothesis, hunger automatically causes the receipt of food to a certain individual, and the fall of the mercury inevitably ends with more coal on one certain fire at a certain time. But these deductions are obviously absurd. The presence, character, and expression of mind-power alone make possible these particular sequences of temporal and spatial events. The physical need is met as it is because a

reasoning power has transcended mechanical routine of the usual sort. The mind of man is imperfect, but not so imperfect as to refuse to accept physical experience as its most reliable guide for its own particular healthfulness. In following a certain mechanical routine, the imperfect mind is being reasonable; but, because that mental routine is usually justified which restores a certain type of physical balance, we should not use the fact that physical harmony is attained in the one organism as a proof of the unreasonableness of viewing mind itself as a separate reality.

Perhaps no one has expressed the theory that mind-power was a disguised physical power more emphatically than Herbert Spencer. He submitted seemingly exhaustive proof that mental actions correspond in quality and intensity with physical cause, and he thought that he had proved his case; but his proof merely attested the fact that human life to-day is mostly physical in its requirements, and largely dependent upon the attainment of certain harmonious relations with the environment. Nothing that Herbert Spencer asserted of the correspondence of mental and physical activities in a body-organism in any way proves that mind and matter subscribe to one and the same principle. He wrote:

> That no idea or feeling arises, save as a result of some physical force expended in producing it, is fast becoming a commonplace of science; and whoever duly weighs the evidence will see that nothing but an overwhelming bias in favor of a preconceived theory, can explain its non-acceptance. How this metamorphosis takes place—how a force existing as motion, heat, or light, can become a mode of consciousness—how it is possible for aerial vibrations to generate the sensation we call soul, or for the forces liberated by chemical changes in the brain to give rise to emotion—these are mysteries which it is impossible to fathom. But they are not profounder mysteries than the transformations of the physical forces into each other. They are not more completely beyond our comprehension than the natures of Mind and Matter.[1]

Spencer's logic was founded principally on the premise that it is inconceivable that something should disappear into

[1] Herbert Spencer: *First Principles*, pp. 193–4.

nothingness. He used this argument with reference to the indestructibility of matter, of the motion of matter, and of force. He says:

> Setting out with the proposition that force can neither come into existence, nor cease to exist, the several foregoing general conclusions inevitably follow. Each manifestation of force can be interpreted only as the effect of some antecedent force; no matter whether it be an inorganic action, an animal movement, a thought, or a feeling. Either this must be conceded, or else it must be asserted that our successive states of consciousness are self-created. Either mental energies, as well as bodily ones, are quantitatively correlated to certain energies expended in their production, and to certain other energies which they initiate; or else nothing must become something, and something must become nothing. The alternatives are, to deny the persistence of force, or to admit that every physical and psychical change is generated by certain antecedent forces, and that from given amounts of such forces neither more nor less of such physical and psychical changes can result. And since the persistence of force, being a datum of consciousness, cannot be denied, its unavoidable corollary must be accepted. [1]

Now, this argument appears more formidable than it is. We can accept it in a general sense, and yet deny it in respect of those particulars which concern us here. We agree that something does not become nothing; but, does this surely signify that matter is indestructible, that the total amount of motion of matter is unchangeable, that the momentum of moving matter is forever the same quantity, whether active or stored on shelves, so to speak? Spencer failed to draw a different possibility from his premise, and thus fell into his great error. He failed to conceive that *matter might be a secondary character,* and that its motion and momentum might be destructible. Matter may even be transformed into something else, and then all its attributes, including its energy of motion, will disappear simultaneously. He seemed—as do most mechanists—even to prefer to surrender all the reality

[1] *Ibid.,* p. 197.

of mind-power rather than accept the suggestion that mechanical principles were subject to independent control.

This misconception vitiated Spencer's philosophy. To be sure he regarded certain forms of matter as secondary, and therefore as impermanent, but matter as a whole, he thought, was a primary essence, and therefore its attributes of motion and inertia might never be lessened quantitatively. Mind-power was dependent on matter-power, an offshoot from it. He believed implicitly that if matter or its energy should disappear something would then have become nothingness. He believed that a disappearance of inertia would signify the loss of something so basically real that it could not thus be eliminated. He did not conceive that even inertia might be a quality derived from a particular arrangement of a more primary essence,—this very mental power that he was willing to depreciate,—and therefore dependent upon the continuation of this arrangement (dependent upon motion-factors, that is) for its continued being.

If Spencer had been asked whether the amount of radium in the universe was constant, he probably would have been less dogmatic than some other physicists of his day. He might have said: "No, it may readily disrupt into simpler elements through an evolutionary process." And if he had been asked whether the amount of water in the universe must forever be constant, he would doubtless have admitted that this, too, was subject to change, because dependent upon other factors. He might have believed that the quantities of the components of water were forever constant, but he would not have been justified in this opinion unless sure that these elements could not be evolved into others.

Spencer would doubtless have admitted the possibility that all water might be solidified into ice, and, after experience had proved it, that all radium might change into lead. The distinctive physical properties which water and radium represented would then have disappeared, but the elimination of these kinds of matter, he might have said, need not make us surrender our belief in the ultimate Conservation of matter and its energy, for water and radium will reappear in other material forms, and their physical qualities and

quantities of motion and inertia will appear in these new forms unchanged. The specific properties of water and radium may be due to certain particular groupings and velocities of unit-particles, and thus may be nothing but secondary and unimportant attributes of the unit of matter. Being secondary, they are transformable into something else with different qualities.

Certainly such a change does not necessarily make a breach in the general principle of mechanical Conservation. Similarly, electricity may be made by a power derived from the heat of coal without destroying our belief in the Conservation of total energy, active and potential. Are not the physicists correct in asserting that: "A motion of ten pounds at a velocity of five feet a second may be exchanged for a movement of fifty pounds at one foot without loss of momentum"? Is it really a loss to lose radium and receive an equal mass of lead and other material forms? Certainly, the radium-quality, as a physical quality, is lost. But what is this physical quality? What has been lost? This, indeed, is the important question, and one which the physicists do not satisfactorily answer, and one which some are willing to forget, for its solution is inconsistent with the axiom of physics.

Secondary quality-groupings—or even elements of matter such as lead and zinc, with their separate and distinct attributes—may be transformed into characters with different attributes without impairment of the principle of mechanical Conservation, say the mechanists. When, however, one goes farther than this, and assumes that matter, and its attributes of motion, and its ability when moving to deliver momentum, are permanent and indestructible, he makes the tacit assumption, as I have said, that matter is primary. Has one the right to assume this, however, or to argue from it as though nothing else were possible? Surely not, unless he is thus enabled to explain phenomena otherwise unexplainable. This, however, he cannot do. Rather the reverse is true, as we shall see. In these terms one cannot even explain his own reasoning mind. Spencer admitted that matter was unknowable, and that most of its qualities

were inconceivable. This mystery, this lack of reasonableness, lurked in the shadows of his theory, yet he clung grimly to his premises.

If the building-block of matter is not a primary principle, then it and its properties will disappear when the structural quality of this block is altered. But before one can say that such a conversion signifies that something primary has disappeared he must prove that this bit of matter is itself something primary, that it is not a particular arrangement-property, and that the absence of the inertia-quality means the presence of nothingness.

Now, as I have said, I do not believe that matter is either primary or permanent. Substance appears to be a mind-power in a certain arrangement the chief characteristic of which is inertia. Substance is subject to *change*. It is composed of a more fundamental essence which is so essentially active and purposeful that it displays no measurable inertia nor mass. If this concept is accepted, the facts of life follow almost as a matter of course. Even Evolution is revealed in the mental quality-change following the material quantity-change. When the only possible re-arrangement occurs in respect of any one unit bit of matter, the attributes of this bit disappear just as the qualities of radium vanish when its typical structure disintegrates. In this process, one which displays fundamental change, the mechanical view of the Conservation principle is proved unsound.

The mechanists assume that matter is primal, but life and its experiences seem plausible only when one accepts the idea that there is a fundamental Evolution of matter into something else. The motions, the structures, the very being of matter, are being altered. Matter is disappearing. The principle of Conservation is broader than physicists usually admit. There is no *mechanical* Conservation. The truer statement of the law would perhaps be: "The quantity of matter-essence plus mind-essence remains a constant—these essences being fundamentally the same." The potential power of mind remains a constant quantity. According to this view the principle of Conservation would not be

breached when mechanical energy was made potential by being stored away for the time on shelves, so to speak.

I may accept the axiom that something may not be converted into nothingness, but I mean by this merely that the total quantity of the primary arrangement of the one essence, mind-power, in the universe can neither be reduced nor increased. This does not mean that matter is permanent. Quite the contrary.

Much of this view is suggested by Walter Pater:

> What the uncorrected sense gives was a false impression of permanence or fixity in things, which have really changed their nature in the very moment in which we see and touch them. And the radical flaw in the current mode of thinking would lie herein: that, reflecting this false or uncorrected sensation, it attributes to the phenomena of experience a durability which does not really belong to them. Imaging forth from those fluid impressions a world of firmly outlined objects, it leads one to regard as a thing stark and dead what is in reality full of animation, of vigour, of the fire of life—that eternal process of nature, of which at a later time Goethe spoke as the "Living Garment," whereby God is seen of us, ever in weaving at the "loom of Time." [1]

The belief that mental power is an aspect of matter, and that mind perfectly subscribes to the mechanical laws of the physicists, leads to many unrealities. It even prevents us from understanding how matter universally moves while, so far as can be observed, staying within certain limited bounds. It also prevents us from realizing how evolutionary change can possibly take place in a way that is "absolute" when referred to the universe as a whole.

What refinement of matter, what material character however subtle, can bestow the power of original movement upon a matter-particle? Does matter *keep itself* forever moving in areas of pressure, and forever restrained within definite bounds? Or does matter as a whole deliberately retrace its own path, purposely reversing its own oscillations at its own chosen bounds? The physicists admit that in a "per-

[1] Walter Pater: *Marius the Epicurean,* p. 97.

fect gas'' there is no cohesive force restraining the motions of the separate particles. A power more potent than attraction must here be introduced to explain the failure of the matter-particles to separate indefinitely.

The mechanists have apparently reached an erroneous concept of mind-power because they have examined it only when associated with physical bodies, and when acting to promote the successful and harmonious life of a body-organism. They regard mind-power when it is perfecting a certain type of mechanical balance,—that which the mind in the organism would naturally elect,—and they then take this accomplishment in its purely physical meaning as a measure of the quality, and as an indication of the character, of the power accomplishing it. They thus incline to force mind into a mechanical groove. In this way they have reached concepts of the nature of mind-power which are as unreal as our ideas of steam would be if derived from considerations of the mechanical movements or physical attributes of the engine which the power of the steam drives. Furthermore, they have never traced to its source the power that creates the general motions of the mechanical pool in which we are immersed. Nor have they discovered the cause of Evolution.

They have concluded, indeed, that the first cause of the motion of matter is unknowable. They have even misconceived the nature of the power within our own bodies, and, after forming erroneous opinions of the nature of consciousness, they have taken refuge in the affirmation that the mental is a subtle aspect of the material, and a character which has been developed through an unknowable (although recognized) process of change. Their theory has thus become a vicious paradox. They rely, not upon philosophical reasoning, but upon rather crude interpretations of mechanical experience; and they do this even when mechanical experiences are mutually contradictory and paradoxical, and even when the explanations of phenomena in purely mechanical terms are mentally inconceivable, and even when the laws applying approximately to the gross experiences do not apply to the finer ones.

The universe seems to present mind-power in two typical relationships with which we are acquainted. In both of these the character of the purposed accomplishment is similar. First there is the mind-power within the life-organisms of our earth—and a very humble and feeble type of mind-power it is. From moment to moment this mind-power is being created by evolution from the body-substance. Then, obviously, it purposefully directs its body-organism (so far as it is able) into that particular mechanical equilibrium with its environment which fosters its continued life. In this way the body-organism attains its most harmonious and successful evolutionary existence. But, beyond ourselves, in universal realms, there appears to exist a general mind-power. It, likewise, acts purposefully with matter in its largest scale, first deliberately giving motions to the material parts, and then with equal deliberation restraining the motions so as to hold the universe within finite bounds. Motions within limited volumes make possible those recurring mechanical contacts by which alone the evolutionary rearrangement of matter takes place. Hasdai Cracas, an early philosopher, thought greatly when he conceived that the universe of matter was the body of God. Surely it is a "body" that the Creating Cause both moves and restrains. The universal power, however, has much more freedom than man has with his own body.

Sir Oliver Lodge says he is beginning to think, from "the somewhat obscure indications of . . . science" that "intelligence is not limited to the surface of planetary masses, but pervades and dominates space; nowhere absent everywhere active."

Philosophers have been unable to comprehend how mind and matter might be parallel characters in a situation where mind "knows" matter. Nor could they understand how such parallels might touch, for the very contact would seem to destroy the idea of parallelism. They have been unable to conceive how one character might "know" the other without touching it. In this perplexity,—one which arose chiefly because they dealt with mechanical events which are being purposefully kept in almost perfect balance, and because they

did not conceive of the Evolution of matter into mind,—they have sometimes agreed with the mechanists that mental power is an attribute of the physical. By conceiving of mind as disguised matter they have thought to escape the need of identifying the point of contact between them. This attitude is somewhat like that of Professor Einstein who says that Time can be changed by relative motion, and who does not explain what is to be subtracted from motion that may be added to Time. An exterior cause must operate, however, whenever change occurs within any whole, and if an inconceivable cause is postulated, the real truth is hidden.

In a recent publication, Professor C. E. M. Joad, of Oxford University, suggests that there may be a pluralism of existing principles in the universe. This pluralism, he avers, consists of different arrangements of a single neutral particular. Mind, he says, may be a certain arrangement, whereas matter may be another arrangement of the same particular. This concept closely approaches my idea of the nature of the universe and of the change that is going on within it. Professor Joad remarked:

> Instead of postulating the existence of two things different in kind, and being, as a consequence, compelled to consign the question of how they are to "get at" each other to the realm of mystery, we may think of the universe as being composed of one fundamental stuff which is arranged in two different contexts or ways.[1]

He conceives that mind is not matter, and that matter is not mind, but that "each is a form of arrangement of a stuff which is more fundamental than either." He says there is an interaction between mind and matter, and he suggests "that this interaction can take place because body and mind are not composed of different stuffs, but are composed of the same stuff differently arranged, the arrangment which we call mind being due to the operation upon the particulars of the principle of life."

[1] Professor C. E. M. Joad, *Mind and Matter*, p. 191.

Why should one suppose that there is a third particular out of which mind is composed. Only two basic qualities now appear in the universe, and it seems more reasonable to conceive that the final reality will be mind-power alone.

In the birth-processes in which mind is created from matter there is a close association of one with the other. And although there is a very definite opposition in the attributes which they respectively exhibit here in this world, this distinction does not prevent their intimate contact during the time that one is being changed (or re-arranged) into the other. The mind should know the material characters as and when they reach, affect, and blend themselves into the mental realm. Farther than this the mind does not attain knowledge of matter through direct experience. The mind "knows" intimately the motions of matter-particles that *reach it,* that are transformed into it; and the mind knows, too, the inertia which it must overcome in moving matter; but the mind does not "know" through experience the interior quality of the particle of matter. Changeless matter cannot be appreciated directly by mind-power, for it is not in relation with mind-power.

That red book on the table there is known to me principally by its redness; but its redness has reached me only through the motions of light-rays which have struck it and then struck me. These light-rays, now red, were white before they struck the book. The energy of the matter composing the book altered the frequency of the sunlight, and I "know" the redness of the book through the conventional change that the energy-structure of a "red" object gives to white light. I should not have knowledge of this mechanical change, however, unless these altered rays now came and affected my own body, and thus gave me a new but typical mental sensation-datum—a new relationship for a flow of thought. It is this new thought, this last effect, that I call the "redness" *of the book.*

I know matter, then, in part by virtue of the messengers which reach me from it, which associate with and thus affect my mind, and which even, at times, create thought and its power in me. These messengers all have motion and

inertia, and though I cannot realize directly what this inertia of itself might be, yet, by the law of opposites (opposites with limited extremes), I dimly sense its reality. Reason informs me that the substance which by its direct motions has created opportunities of mental sensations (and perhaps mental powers in me also) is real, and, for the present, is something in itself. I am also informed that this material bit, now that it has reached me with a mental quality-effect, is different from what it was. A former material quality must have been surrendered directly to my mind. What is this former quality which has now suffered change, and which, through some process of evolution, has been enabled to reach mental realms?

When we raise a stone, we feel a resistance. The stone participates in a general mechanical equilibrium (as established by the general mind-power, no doubt) whose terms cannot be altered except by the use of "absolute" power. We therefore "know" something of the nature of the stone through consideration of its resistance to our mental will. Moreover, when light comes to our eyes as the result of a collision, it brings us some of its mechanical characteristics. We realize, too, that a moving mass encounters resistance when it meets another body at rest. The moving mass before the contact, we may suppose, had reached an equilibrium with its state of motion, whereas the one at rest had attained an equilibrium in reference to a point of quietude. Each, however, is in its own state of equilibrium, and each clings jealously to a certain space-volume. When, therefore these two objects meet, the collision develops a new necessity. Because the two masses cannot freely penetrate each other, the two different equilibria must be adjusted when they meet. One surrenders motion which the other accepts, and a new condition of energy-harmony is established which is a compromise. The necessity that there should be a mechanical equilibrium may be traced to the principle that the universe consists of inert material objects that are being subjected to restrained movements. Except for the mental principle which induces restraint the universe would spread in space until inertia became an unused attribute.

The human mind obtains knowledge of the physical environment, as we perceive, because of its intimate association with the messengers reaching it from the oscillating and changing energy-volumes composing the physical universe. So far as these messengers are typical, the mind-power with sufficient capacity will have a clear understanding of the energy-conditions (that is, the motion-conditions) of the parent-bodies from which the messengers emanate. This very association with the environment has enabled us to know that matter usually clings jealously to a certain space-volume. Unless matter possessed this property, it could not (with motion added) express through contacts those qualities which it does express. By reasoning backward from the qualities of the messengers that reach us to the qualities of the parent-source of which they are typical, we obtain a general mental concept of the space-monopolizing characteristics of unit matter, as well as of the restrained nature of the universe in general. In the same way, we gain knowledge of the temperature, colour, and hardness of a body which we have never "known" directly, and with which we have never been in any sort of intimate contact.

What greater certainty can we have, then, than that material structures exist which are the sources of these continuing messengers to our mind? To be sure, the great mass of this substance may be hidden and unrevealed, and, in this sense, it may not be directly known, but, even so, typical representatives come to us from the surface-layers, and these, in turn, are affected by the mass-movements beyond. We may not see, hear, nor feel the inside of our earth, but the significant nature, even of its massive center, is conveyed to us dimly, first by its occupancy of space, and, also, importantly, by its consequent resistance to aggressions—even to our aggressions. And we "know" the surface of the earth directly. Its messengers reach us, give us sense-data. Not only this, but some of them create mind-power within us. Matter is sometimes associated with mind in the intimacy of creation. Hence, if sufficiently wise, we might know even the hidden core of our world, and the mechanical structure of the far star as well. Fortunately for knowledge, and for

the establishment of simple laws for dependable reference and use, the mechanical energy of the universe, as most important to us, is contained in typical structures. And since these matter-structures are everywhere, and since messengers come from everywhere, then, if it be true that part of the mechanical energy of some of these messengers becomes our own mental energy, and if associations with them give us an opportunity of "knowing" their energy-relationships, why should we not "know" energy-relationships everywhere?

When Bishop Berkeley said that the mind could never "know" the mechanical world, he did not know how the redness of a book was revealed. He did not realize that typical energy-messengers (charged with mentally given motion-qualities) came to his mind from that redness, and that he knew these—the mentally natured qualities. Far less did he realize that some of these contacts, by their changes in his bodily arrangements and in his mental forces as well, made real not only the sense-data subject to his memory, but also the mind-power within him. The knowledge of man of the universe comes, then, not from direct contact with the large structures of matter, but from the mental changes set up in mind and body by the receipts of invisibly small—and yet sufficiently typical—energy-representatives in series as sent directly from certain energy-volumes or as reflected from them. And the matter which does affect man's mind directly *will not be represented as matter again to the extent that the effect has reached mental realms.* Indeed, as far as the physical has reached mental realms in the process of Evolution, it will henceforth no longer be matter.

And this messenger from the outside which has left its mechanical effect in the man's body (and which has thus created a new bodily relationship of which the man's mind may be conscious, as it subjectively treats with its body), is representative in mechanical type of the matter whence it came, and the man can realize this type in so far as he can appreciate the quality which he himself displays when he uses his mental powers to move the inert matter of his own body. Man can therefore realize both the motions and in-

ertias of particles because he obtains separate effects from the mental and physical parts of his dualistic body. These sources of understanding are enough to enable him to know as much as he does know about matter.

And why should not the mind be conscious, as such, of motions which reach it? Motion, after all, is a mental attribute first given off by mind and then received back into mind. Its quality is known by mind because, basically, it is mental. And inertia, in one sense, is mentally determinable quantitatively in terms of the amount of mental power required to give motion to a certain amount of matter. Why, then, should not a mind appreciate inertia and its motions? Indeed, there would be no flow of mind-power in man unless these motions of matter came against him and created mind-power within him!

Had Berkeley been aware of the physical facts, had he accepted the transformation of matter into mind, he might have attempted to confirm the reality of his mental power from the seeming greater reality of the matter almost continually in motion against his body. He could have argued that his mind-power was surely real because a surely real matter came from the outside repeatedly against him, finally reaching mental realms with an effect. Here, in mind, the energy of matter does not accumulate. Nor does it seem again to return to material realms. A man's mind-power must be realized, then, as that something into which the matter-quality has been *transformed.*

Bishop Berkeley would not have asserted so positively that man could not have knowledge of matter if he had reached a proper concept of the two realities of the dualism, and of their relationships and definitions. He did, however, attribute properly the cause of all motions—and, therefore, of all sensations—to a universal and spiritual Cause of motion: and if he had but realized that the material quality may disappear into something as real (but as intangible, imponderable, and therefore as non-material) as mind-power, he could perhaps have deduced the nature of the inner being of that matter from whose blow mind-power was created. With this difference of concept he might have demonstrated

the reality of that evolutionary process through which his mind-power made its new and significant appearance within a physical body of which it was conscious.

There is more quality-opposition between mind and matter than parallelism. Nevertheless, they have in the creation of one from the other an intimate association, contact, and opportunity of knowledge. This intimacy is similar to that *which the subject has of its object,* or that which the steam has of the water from which it is being evaporated. The conception of Evolution as a mental accomplishment, a process developed by rearrangment, seems to solve the puzzle of the association of mind with matter—so far as that association extends. Furthermore, as later shown, application of this idea to mechanics adds an understandable and proper relativity to mechanical formulas. Since, however, we are here considering mental relationships, it may be well to discuss other aspects of the mind.

Inherited instinct and memory are virtually identical. In the simplest form of life they cannot be distinguished. The protoplasm reproduces itself by the subdivision of its body into two parts, and its instinct and memory cannot be differentiated. While we reproduce differently, nevertheless, like the subdivisions of the protoplasm, we inherit a physical body which contains records of events previously experienced. There is no gap in our inheritance of physical cell-structures in which past experiences are recorded. Furthermore, we inherit neither memory nor instinct, but merely the characteristic body-cells with their time-marked structures. From these inherited cells there flows a stream of mental power created anew from moment to moment, which, derived from the body, and operating the matter of it, is capable of interpreting its past history from the changed conditions created in its structure. This mental power arising from the newly formed germ-plasm doubtless composes and arranges the new body according to its will. The body itself, however, is the inheritance—not the mind.

After the characteristic cell-structure has been received, there flows from it a characteristic mental stream which regulates, operates, and, during youth at least, amplifies the body-

structure. The life of the protoplasm is potentially immortal. It will live as long as the external environment is favorable. From the usual body of a life-organism like the protoplasm there flows a continuing stream of mental energy which appears to be created from and within the characteristic body-substance (or cell) by those re-arrangements brought about by the repeated blows of exterior matter. This exterior matter, in turn, appears to be "charged" with motion by an exterior and more universal mental energy. In the collisions of exterior matter with the body-physique, some of the material arrangements of the cell-structures break down, and, apparently, a mental power is released.

Now this mental principle, emanating, as it seems to do, from the body, is associated not only with the physical energy-experiences of the body, but with its past record. The association is as close as that of the water with the basin of the spring from which it bubbles, or, speaking more generally, as the relationship of the created with that from which it is being created. The physique of the body-source may be old, but the mental consciousness is new, like the brook that flows from the ancient spring-basin. The new comes out of the old, the present is derived from the past, and the association of the two, during this period of creation of the one from the other, is intimate indeed.

A certain charge of mind-power, therefore, if this theory be sound, lives in the body as little as certain water remains forever in the spring-basin. Nevertheless, mind-power flows constantly, and that which flows is forever typical of, and is also constantly within, the body from which it appears—just as steam is forever typical of and within the boiler from which it finally emanates.

The physical body within which the created mind-power finds itself, and which the mind thenceforth organizes, is marked with the record of old experiences, and this physical structure properly serves to guide the mental powers in future conduct. When a mind-power analyzes the experiences inherited from preceding generations this judgment of the old record of its body-structure is called instinct, but when the judgment is taken of a record that has been made

during the lifetime in question, it is called memory. Between memory and instinct there lies in the protoplasm the chasm of an evolutionary fission of a single physical body, but, in human beings, there intervenes the junction of two bodies into one, followed by the fission. The principle is the same in both cases. In human beings, however, only the superior and victorious half of the germ-plasm encounters life-experiences. The inferior half is not even born.

We seem now to have reached an important conclusion: The human mental power is formed primarily from discontinuous events, by the intermittent blows of matter-particles —and they strike separately. For it to be otherwise the universe must needs be one solid mass. If, then, the mind-power arises from the collisions of separated matter-bodies, its creation must be as discontinuous as the creation of a stream from raindrops. Even if this be true, however, the presence of mind-power in the living body-organism may be as continuous as the presence of water in the stream. Is thought (here defined in one aspect as the result of the activity of mind-power with its physical environment) discontinuous, then, or continuing? Or is there perhaps more than one variety of thought, one continuing of its own nature and subjectively active, and another discontinuous because created from the intermittent mechanical impulses of the environment?

M. Bergson uses the analogy of the cinema to illustrate the discontinuity in our means of acquiring knowledge of the external world through the medium of sensations (and our thoughts of sensations), but this discontinuity, he claims, is mentally refashioned, and thus reconstituted by mind into a continuity. According to him, duration—even the duration of that consciousness which is due to sensational impulses—is a continuous process. Consciousness and life-experience is a "continuity that unfolds."

His analogy interests us. The series of different photographs of the cinema affords our minds (through our faculty of vision) the consciousness of a continuous display of images. Yet, this viewpoint, as naturally taken by the audience, is known to be erroneous by the operator of the

projecting machine. The photographs and the mental sensations,—since both are derived solely from reflected light-rays,—are discontinuous, hence our conscious mental understanding, or seeming knowledge of the phenomenon, must be erroneous. Indeed, if the mental consciousness of each photograph is derived solely and directly from the energy-receipt of the light coming from it, the consciousness must be received and grasped immediately. Such a mechanical sense-datum is not only discontinuous, but it must be appreciated instantaneously if it is to be realized mentally as an event that is taking place. The consciousness of a series of photographs, or even of one photograph, could not endure, therefore, with seeming continuity, except by the use of some principle which has no reference to the mechanical events as and when they are taking place.

Perhaps we are deceived in our concept of our own consciousness, just as we are deceived, obviously, in our understanding of the nature of the series of motion pictures. Perhaps consciousness itself merely seems to us to be continuous when, in fact, it is intermittent. Perhaps we cannot realize that our consciousness is intermittent merely because we have no sensational consciousness during the intervals when there are no images on the screen of life to give us sensational impressions.

No, this could not be true, for we do have other sensations—between the photographs of the moving pictures, for example. Perhaps, however, these other sensations also are instantaneous and intermittent. Perhaps all consciousness, at least in so far as it refers to external events, partakes of the discontinuity and immediateness of the exterior impulses themselves, and we are deceived about our thoughts derived from them. Perhaps, that is, we do not use memory as a means of making the consciousness of an impulse persist after the sensational cause has ceased.

And yet, there is another possibility: Perhaps a physical oscillation is generated in our bodies by a series of impulses from the outside, a continuing and rhythmic movement which starts with the first impulse, and which persists in our bodies even after the series of impulses has

ceased, just as the banjo string continues to vibrate after the finger has plucked it one time. Perhaps our minds are conscious of this continuing internal body-movement which begins with the first image of the cinema and persists even through the intervals of darkness. In such case, the feeling of continuing consciousness would be somehow due to the continuity of motion of the internal physical events. Appreciating the continuing motions of the sense-data as developed in our body, we might be deceived into viewing the continuity of appreciation as thus derived as being due to the continuity of energy-receipt from the outside. We might easily thus arrive at false concepts of what the exterior facts were. And yet even our appreciations of the continuing internal oscillations of our sense-organs may themselves lack continuity.

If we could think only in terms of the sensations derived from the blows of striking matter, external or internal, we could think scarcely for any duration, for matter delivers its energy intermittently and immediately. We may then be without consciousness except during immediate intervals. Possibly we do not have a true concept of the passage of real time. We may perhaps have no thoughts during the unconscious intervals—and, therefore, not even a consciousness *of* the intervals.

Now, without doubt, much of our appreciation of the exterior world does come from intermittent sensational impulses similar to those received when we look at moving pictures. And, obviously, in such cases we may be deceived as to the external facts by the nature of our own sense-impressions. We are, as we have said, completely unaware of the intervals between the pictures. Nor can we realize that the energy of the light-rays from the pictures (and from all sources) is delivered intermittently and instantly. We cannot tell what percentage of the elapsed time the screen of the cinema is blank. Unless it could be positively proved to us in some other way than by our vision, we of the audience would likely vigorously deny that the screen was ever blank. We would assert that the time of the display coincided with the total elapsed time. We would also be firm

in the opinion that here was proved continuity—both of the sensations and of the mechanical impulses producing the sensation. Or, if the light producing the pictures was under consideration, we would affirm that it, too, was continuous. Yet, in every way we would be mistaken. Nevertheless, we would be convinced that our judgment was sound because we would be relying upon that which is usually regarded as the best source of knowledge.

Probably correct conclusions are never attained directly from specific experiences *with* matter. Such experiences are too generalized to be exact. And there is another way of acquiring knowledge. If a spectator argued from the belief derived from general reasoning that continuity of picture-projection was impossible *in the very nature of things,* if he contended that the subject-matter on the screen *could* not change unless one picture was substituted for another, and, if he claimed, further, that there necessarily must be a time-interval during which the substitution of one picture for another takes place (whether or not it can be realized) he would reach a more accurate conclusion than the empiricist who relies entirely on the mental interpretation of the immediate sense-data. Thus for many hundreds of years it has been erroneously deduced from experience that light-rays are continuous, yet the conclusion might have been reached through a process of general reasoning that the continuity of any type of mechanical phenomena (as other things are) was impossible. Even so, the typical modern empiricist denies the philosopher the right to determine the truth of phenomena from principles of general reasonableness. Many still affirm to-day, for example, that the continuity of gravitational force is possible. And many think that the mental appreciation is the disguised effect of a mechanical cause.

Our understanding that the specific sensational experience often leads to an incorrect view, and that this erroneous opinion can be corrected by reference to realms unrelated to the event in question, is important. Several propositions seem to be demonstrated by it. The thought, which, by reaching realms beyond the "appearance" of the experience itself,

denies those facts which only seem to be disclosed (as in the case of the cinema), is not itself derived from the specific experience. Certainly, therefore, all thought does not refer to, and is not the mechanical equivalent of, the physical cause which, at the moment, arouses the sensation. All knowledge, therefore, is not derived from the sense-datum itself. Indeed, the reality of a thought (its own essential quality) may be entirely independent of the mechanical impression of the moment to which the thought refers. If the reverse were true, if the cause-effect sequence from matter to thought was definable in mechanical terms; if matter in motion was the cause, and mind-action the mechanical effect of the delivered impulses, if, after all, a thought was nothing but disguised mechanics, then the space-and-time-harmony between a thought and its materialistic cause should be perfect. None of the thought should fail, then, to spring from those mechanical energy-deliveries with which the mental power is *at that time* concerned.

Is thought to be regarded, however, as in any way the normal sequence-relationship concluding a chain of events strictly mechanical from end to end? We believe not. If a mind-action was mechanically grounded, if it was derived in accordance with the normal space-and-time-relationships of the physical world, if it sprang, that is, directly from the motion-relationships of matter-bodies, it could not be (as, obviously, it is) derived even partly from a mechanical event that took place so long ago that no part of the mechanical action now exists. A mental judgment, if it is to follow mechanical principles, if it is to subscribe to the mechanical definition, must be created in the proper mechanical relationships of space, time, and direction with the action. It must follow its mechanical energy-cause in the proper way, and at the proper interval. It must be the materialistically inevitable conclusion of the mechanical impression of that particular moment, or else it cannot be regarded by any stretch of the imagination as the mechanical effect. Since, however, the creation of a thought does not subscribe to these mechanical necessities, we conclude that mental power is not the mechanical ending of a motion-relationship in the physical

world. On the contrary, it appears to us that every relationship between mind and matter must spring from the essential quality of mind as *active subject.* We are convinced that the mental quality does not in any way subscribe to the mechanical definition. That is to say—it does not arise as the object of a mechanical cause-effect sequence.

The conclusion that mind-power bears only a subjective relationship to sensed experience does not justify the view, however, that thought is independent of the mechanical environment to the degree that its conscious realizations would be the same whatever the physical impressions of the environment might be. If a mind-power existed within an isolated body-organism never subjected to physical contacts, no thoughts of the nature of the outside would be aroused. The fact that thoughts concerning a physical environment depend for their being upon the active presence of such an environment, should not be used, however, as a support for the view, just renounced, that thought is the mechanical result of a mechanical cause. We must not accept this fallacious reasoning so many times advanced. The mechanical environment is in constant pulsating motions, some of which are unusual, and some of which, therefore, are capable of delivering appreciable (we appreciate the abnormal) vibrations to our organs of sensation. Certain series of these mechanical momenta against the body-organism are transmitted in typical fashion to the seat of consciousness where they become the *objects* of the attentive thought of the mental power residing within the organism. The mind-power seizes upon these physical contacts as the objects of its thoughts, and, at least in part, forms mental judgments of the environment through its own subjective mental interpretation of these impressions of the moment. Thus the mind of the organism obtains useful knowledge of the momentary quality of the environment—but through a subjective relationship with the physical situation, and not as is object, not as a new form of physical reality mechanically created.

A stone, which is a mechanically perfect organization of the typical atoms, which constitutes and exhibits all the properties coming under the mechanical definition, and which,

therefore, is able to receive in perfect mechanical form (that is, in a way that subscribes perfectly to the mechanical laws) all the mechanical properties of a physical blow, and which can act in the necessary mechanical sequence with typical result, which can perfectly take the part of the mechanical object of a mechanically grounded cause-effect relationship, does not, so far as we know, derive from the mechanical impressions either thoughts, mental judgments, volitions, powers of choice, or an independent ability to move. The mind-power of a life-organism, therefore, has relationships with the mechanical activities impressing its body-organism which are distinct from those conforming to the necessities of a strictly mechanical chain of events.

We completely distinguish the physical from the mental, therefore, when we say that the relation of mind-power with a moving matter-body in its environment is completely subjective. This distinction affords us the terms of a clear-cut dualism, for, so far as we can observe, a physical object at rest has only objective relationships with the mechanical momenta impressing it. It yields to the blow as an object, moving away in the direction of the force-action. Moreover, the yielding movements of the material object are in perfect correspondence with the mechanical principle of Conservation. They follow the mechanical rule that a certain result (one definitely assured in time, space, and in direction of movement) shall follow a certain type of impression.

The physical realities of being and of behaviour are thus completely distinguished from the mental. The mechanical impressions against the physical body do not create the thoughts—that is, the thoughts of the living organism are not the objects of the blows in the sense that they are subject to a mechanical definition. On the contrary, the mind-power treats subjectively with these impressions.

Not only is a thought so entirely independent of the mechanical reality that no physical impressions reach the mind as mechanical causes having mechanical effects in the mind, but (as we have observed in the illustration of the cinema), before the mind-power of an organism can reach an approximately correct judgment of the physical environment then

delivering mechanical energy-impressions to the sense-organs, it must associate itself with fields, which, mechanically speaking, are completely disassociated from the activities of the present mechanical reality. To form a correct judgment of the present the mind-power must refer itself to past events still subject to its memory-processes. It must reach its conclusions from mental judgments formed from earlier experiences now complete and mechanically balanced.

The child without experience cannot comprehend the necessities of a situation that his father adequately appreciates. Past experience, subjectively reviewed by the mind, and deliberately associated by the mind with the subjective mental view of the mechanical impressions of the present, forms the basis of our mental judgments of the present experiences. No power other than the mental can thus subjectively associate the past experience with the present, and no power able to do this can be regarded as subscribing to the mechanical definition. The entire thought-process is mentally subjective, and time-spread, whereas the mechanical reflex is entirely objective, and immediately accomplished unit by unit.

When the subjective mental power attempts to rely exclusively upon judgments formed from the "appearances" of the mechanical impressions *of the moment,* it may reach erroneous opinions of the mechanical nature of the event. Mental conclusions, must be adjusted by mental references to principles of general reasonableness—to broad judgments founded upon conclusions reached broadly through the averaging (so to speak) of the mechanical impressions. Let us consider a judgment thus founded.

From our general experiences with matter we have reached the conclusion that it possesses inertia. We are therefore justified in concluding that two bits of matter cannot occupy one volume simultaneously. General experience seems to verify this. If this be true, however, we can use this concept as a means of forming a correct theory of the processes of the cinema. Our mind, relying upon this definition of matter (a definition which itself is founded upon an averaging of all our experiences with material objects), has the right to conclude from an act of general reasoning that two mov-

ing pictures cannot simultaneously occupy the screen. If, therefore, the subject-matter of the photographs changes, one photograph cannot remain continuously on the screen. We are therefore informed mentally that there must be a period of unrealized change during which one photograph is removed and another is brought into the space-relationships of its predecessor. This correct mental conclusion is not derived directly from the sensational experiences then expressing their mechanical realities.

The specific sensational experience is thus exposed as a deceptive and inadequate guide to knowledge. The principles of truth are derived mentally from those definitions of the prime realities of the world which are mentally acceptable, and those definitions of the particulars, of mind itself and of matter, *are* mentally acceptable which seem to identify to our mental judgment the reasonableness of those things which from moment to moment happen. Thus we attribute to matter the inability to share space with other matter because our usual experience with material objects seems to prove that the unit of matter composing those objects is thus to be defined. No other conclusion seems to be compatible with general experience. From the same type of general process of reasoning from customary experiences to the definition of the unit of reality composing these generalized events, we conclude that matter does not possess the power of independent motion. We thus arrive at two conclusions concerning the qualities of the unit of matter. And these conclusions, as thus reached through subjective mental interpretations of the usual experience, if they are sound, should give us information about the necessities of every relationship in which the unit of matter is involved. If the situation is such that only units of matter are involved,—that is, if the situation is entirely mechanical,—we should know all of its necessary terms. We are thus informed in general terms that continuity of a changing mechanical activity is impossible provided that the act is one in which those material qualities subscribing to the definition of matter are exemplified. Indeed, if a thought were objectively dependent upon the specific sensational experience for its reality it

would be as intermittent as the experienced impulses creating the thoughts were discontinuous in space and time.

Now, since we can reach conclusions that are independent of the specific sensational experience, we *must* think between the sensational experiences. Such thoughts have no relationship with any mechanical impressions then existing. Even though the truth of this be granted, however, we should realize that our mind-power itself, as above claimed, is derived from the blows of intermittent corpuscles, whereas the thought of this mind-power may, as subject, treat with matter as its object.

Let us again use the analogy of the engine. The steam appears intermittently from the dissolving molecule of water, but, so long as the engine operates, there will never be a time when there is no steam within the cylinders. Therefore, if the steam alone has the ability to think (and the steam, we note is not itself water, and does not express a water-like reflex of the water-properties), it may have a *continuous* consciousness of the personality of the engine which it is operating. Whether or not this is a fact depends upon the nature of thought. The thought-activity may continuously impress (or be conscious of) the physical environment even though the environment itself expresses energy only in intermittent granules—and, therefore, acts only discontinuously against unit area. Yet, if the unit of matter has extension, it may (in multiple formation) be able to deliver continuous energy to a sufficiently large composite structure when regarded as a whole. Thus bullets from a single rifle, or from a hundred parallel rifles, will strike a single area the size of one bullet discontinuously, but bullets from a billion guns by overlapping each other can deliver unceasing energy to the surface of a large sheet of metal (when taken as a whole) or to a deep volume regarded as whole. This principle of possible continuity, however, in one sense is based upon a misconception, for no composite structure *is* tied together continuously in depth or width as a whole. The continuity of energy-delivery from the blows of multiple units of moving matter (each with a definite continuity of extension of its own being) would be possible, therefore, only if these particles converged

in overlapping fashion (when viewed along radial lines) against a single particle. A continuation of such a state of affairs, however, appears to be impossible, for it is incompatible with our definition of matter.

The action of the mind with matter (not of matter with the mind), however, may, in some respects, be unceasing! We believe that we can think continually. We believe, too, that we can think independently of materialistic associations. Even so, however, in those thought-relations derived directly from the unusual blows of sound, light, smell or touch as received from the environment, that is, in all the thoughts stimulated *"sensationally"* by a specific set of experiences with exterior phenomena, the analogy of the cinema probably applies. The thought-relationships may well seem continuous at a time when in truth they are discontinuous.

This explanation may help to dissolve the mystery of the seeming continuity of experience in a world wherein reason tells us that mechanical energy is delivered from one unit of matter to another in intermittent blows. It should also help us to dispel some of our fallacious opinions concerning the "necessary" continuity of certain mechanical phenomena.

Let us then regard physical Evolution as a mentally arranged programme for the transformation of matter into mind. Let us view it, however, as a process as discontinuous as the blows of matter that strike us. Let us also regard instinct as a physical, not as a mental inheritance. Let us remember, too, that in the inherited physical body there are grooves made by old experiences which the subconscious mind follows as the easiest and best procedure. Certain aspects of thought may be regarded as partaking of time, whereas the delivery of unit energy does not. We should also note the other quality-distinctions between the two parts of the dualistic world. We should understand that if the mind follows too closely the physical guides to conduct, or if it follows them according to an erroneous judgment (and exercises an improper choice in selecting the activity that it can ordain), it will often be lead to an unbalanced rather than to a balanced relationship with the physical environment of the body. With these viewpoints and premises, we more will-

ingly accept the conclusion that a mind-driven act is not the equivalent of mechanical reflex, but that it represents a power independent of mechanical formulation.

I shall hope to prove later that the motions of matter-particles may be cancelled without mechanical compensation. If this were so, the motions of matter would soon cease except for the active presence of a cause of motion which lies outside the definition of matter. This concept fits in with the argument which postulates a finite and mentally restrained universe. Purpose, and the power to accomplish the purpose by motion, must be attributed to the universal mental power. This hypothesis, if correct, should give us a picture of the universe more as it is, and should aid us in understanding its happenings. Within, and external to, our bodies, the mentally caused movements, we believe, are centred on the planned accomplishment of a physical decreasing and a mental increasing.

The mind in its body seems to be somewhat like the unhatched chick in its shell. The chick appears in the egg. It is created from the matter of the egg by an evolutionary transformation therein. Until the chick is hatched it must submit to all the physical conditions and restrictions imposed upon it by the egg-physique. It must try to maintain a balance with the physical necessities of its environment. Yet, before hatching, the chick exhibits its two great organic powers: It moves matter: Indeed, it completely reorganizes the matter inside the shell: Then, finally, it attacks the shell itself with a purpose. The life-energy of the chick finally conquers even the inert matter of its restraining wall; the shell finally submits to the mastery of a force which is "absolute" in respect of it. This mental force has persisted in one purposed direction with never an equal reaction. The young life breaks from its prison and emerges into a larger world where it may express its power over matter in a larger way. At least it may be said that the personality as later expressed in the world outside of the shell is not restricted by the earlier necessities of the egg-like existence.

Our analogy is not altogether perfect. The physical environment outside the shell still restricts. It limits the life-

activities to the problem principally of maintaining a physical balance with a physical world. The world-forces exterior to the egg are similar to those within it. Nevertheless, the living conditions are somewhat different. Outside, the chick continues to move matter with purpose, but it is a more generalized matter. Another barrier must yield before the chick can escape into its larger freedom, and to its most general purpose. It must penetrate the shell of the earth-environment. If the earth outside the egg were really the spiritual world, if the shell of the egg were the only matter with which the mental energy of the chick must contend—that is to say, if our analogy applied more closely to the escape of the mind from the body—the change of conditions by hatching would be as impressive and revolutionary as the escape of the mind from its particular body-organism, for, after this escape, the mind is nowise limited by the fate of a particular bit of matter but is free to exercise its independent will and purpose with the material universe at large.

In our definitions, first, of matter (the compound), and secondly, of mind (the simple essence), we draw clear-cut uncompromising lines between their respective attributes. In the relation of matter with mind there are no discoverable shades of attachment of one to the other, and no refinements in forms, positions, or qualities which might merge their definitions. These connecting bonds between material and mental attributes which some philosophers assume—as if the mind-quality could somehow approach in type the matter-quality —these refinements of the physical which they describe mystically as psycho-physical characters, are unknown and inconceivable.

The unit of matter appears to be itself and nothing else. It is either "charged" with motion in relation to the centre of the universe or it is at rest. It moves either in semi-permanent group-formations or by itself. It has no other possibilities. We cannot conceive of continuous change in the smallest unit of matter, or of any change stopping short of complete transformation. The smallest bit of matter is either fully itself, or else it is non-matter. We see no place for a hazy area, or for a gradual and misty bridge extend-

ing permanently from the unit of matter to mind. And we can conceive of no partially altered smallest bit which differs from another in some slightly mental particular. No experience with matter justifies a belief in the possible variations in its unit. Instead of perceiving such gradations which might be characterized as mental phenomena, we perceive no change in the particle except the one sharp, abrupt, precipice of transformation by which matter is instantaneously converted into its mental essence.

Biology teaches the same principle. The mutations which mark the steps of organic evolution, never linger in time; they are never subject to the vision of even a moment. The smallest change is never a gradual slope consuming time for its traversal, but is an abrupt transformation that consumes no appreciable duration in its self-expression. The gradations of mechanical impressions received from different physical structures represent nothing more than different spacings, velocities, and frequencies of the uniform unit-particles composing them. The corpuscles exhibit different sensational effects as they impinge, but this difference occurs only because they strike in different series, over different areas, and with different relative velocities. All these impressions, however, display nothing but mechanical inertia—itself a secondary and temporary quality.

The primary cause, the cause of limited but repeated motions, is usually absent from the mechanistic picture; whereas the secondary effects, the sensations resulting from materialistic blows, are usually discussed and analyzed as if these attributes of matter were revelations of primary characters, and as if accounts of their static states could even reveal Evolution, or anything worth while. As Evolution proceeds, an almost infinite number of series of unit blows may be manifested, and even changing averages in these expressions may be expected; but these impressions, as viewed one by one, are mechanical manifestations.

When the physical arrangement breaks down, when the matter-particle loses its physical character, its transformation into mental power is perhaps immediate and certainly uni-directional. This conclusion follows if one can admit

that the unit-particle is one thing and never two different sets of properties at once.

There can be no lingering slope of connection, partly material and partly mental, in one unit. The unit does not have parts one of which might exist as a matter-structure, while another part then exhibits the formlessness of spirit. We can discover no evidence of such a hybrid formation. Material units which differ because different degrees of mental power are clinging to them like seaweed, are inconceivable. When Evolution strikes, we believe, the material character of inertness immediately becomes the spiritual force possessing activity. Purposeless matter then appears as purposeful mind. The old inertness has become the new activity; and the transformation has occurred as fast as thought can move. Comprehension of this process, and of its immediateness, may clear up many of our difficulties.

In later chapters I shall contend that every evolutionary event occurs without use of Time or Space. Every energy-transfer is made instantaneously, I claim, and matter-particles move only because they are "charged" by the mind-power with the mental attribute, the will-to-move. If mental power were merely a refinement of a physical attribute, as Professor John Dewey has suggested in his book *Experience and Nature,* the "charge" of motion that mind-power gives to matter could no more pass from particle to particle instantaneously than matter could move through empty space with infinite velocity. If mind were but some refined form of matter the two must follow the same general law. How then does thought fly to the farthest star without appreciable time-interval?

Evidence that motion passes from particle to particle instantaneously gives equal proof, therefore, that the mental power is in no way related to matter. The converse argument is valid, also. If mind and matter are distinct and separate arrangements, and if matter moves only because "charged" with a mental power or will, then this motion, or "charge" of will should pass from one particle of matter to another with the velocity of pure thought. If, in evolutionary changes, the mutations of which biology treats occur so im-

mediately that they cannot be observed, we should feel supported in our belief that the "charge" of motion as transferred from particle to particle may well pass without use of time or space.

Since we must further discuss the relationship of matter with mind in order to clarify our ideas of Space and Time, the next chapter will be devoted to other aspects of this relationship.

Before closing this long chapter, I shall quote from a modern writer. Professor Joseph A. Leighton, in his discussion of materialism, says:

> If the sum total of energy in the universe is constant, and if the doing of work always involves the passage of energy from available to unavailable forms, then either the universe is finite in duration, or there is a creative source of energy which compensates for the passage of available into unavailable forms. If we do not assume this, then we must assume that the universe is running down, that is, is tending to equilibrium, and that the time is coming when there will be *nothing doing.* If the universe has existed through infinite time, then it must have run down long ago. Infinite energy, in amount, is not a sum total; it is not a so much. The term "infinite sum" has no meaning; a universe consisting of a definite quantity of energy, however great, would be finite. A universe which had no beginning is not finite and it can have no ending. Thus we are led to the view that the universe cannot be a perpetual motion machine containing a definite quantum of energy. The second law of thermodynamics, when thought out, requires us to assume, if the universe is endless in duration, a Creative Source of Energy.[1]

Then he adds, "The power of the mind to influence the body is just as well attested a fact as the converse." And he goes on to say: "The scientific-minded materialist appeals to the doctrine of the conservation of energy as his last resort, and he assumes that this supports his theory. As we have stated above, this is only a working hypothesis

[1] Joseph A. Leighton: *The Field of Philosophy,* p. 208.

and we do not take this as our *sole* guiding principle."

Finally, he ends the chapter strongly thus:

> In short, matter, in the scientific sense, is a moving configuration of mass particles in space; or, in terms of the latest theory, a system of electrically charged positions in space. It has none of the qualities which we perceive in the actual physical world, the realm of sense experience. It has not the colors, shapes, sizes, motions, sounds, odors, tastes, feels, and warmth and cold, which we attribute to physical objects. It is devoid of all "secondary" qualities and all "primary" qualities too, except, in exceedingly comminuted form, position, inertia, attraction, and relation in space. Even more strikingly is it devoid of the "tertiary" or æsthetic qualities of beauty, grandeur, picturesqueness, sublimity, majesty, or homely friendliness. Scientifically conceived matter is not the *nature* or *physical world,* which man, through his whole being, acts on, is acted on by, struggles and communes with, in part knows and masters and, in part, is mastered by. It is inconceivable that such a ghostly fabric, woven by the mathematical imagination however deftly, and however useful it be as a web on which to stretch physical calculations, should be the *ultimate and sole reality of which mind is but the shadow occasionally thrown hither and yon on the evershifting web—Mind, with its power to select, generalize, abstract, remember, invent, devise, imagine, purpose, and execute, to build up a new environment of social institutions and values, and to create a spiritual world of justice, integrity, love, beauty, and fellowship. To say that mind is the by-product of mass particles is to assume that the whole superphysical realm of human and cultural life and values, including the "Nature" of our common human experience, is the blindly produced, inexplicable, and superfluous effect of impacts and tensions in a realm of ghostly entities which is itself the offspring of the constructive imagination of the physicist.* Surely this is making the cart draw the horse with a vengeance.[1]

And if it is true, as we have assumed, that the matter-quality is basically the mental essence in an inactive state, the ability of the mind to make matter move can be explained

[1] *Ibid.,* pp. 222–223.

as nothing more than an example of the willingness of the passive mind-essence to obey the commands of a more active mind-principle—just as the person in a passive hypnotic trance obeys the commands of the hypnotizer.

CHAPTER VII

THE CONTACT BETWEEN MIND AND MATTER

Life guides and directs both chemical and physical forces, exhibits purpose and will, and in its higher spheres also sensation and consciousness. It is a point-blank contradiction, and very nearly a philosophical impossibility in scientific systems. What is it?

PETER COOK.

THE eminent English writer, Professor Karl Pearson, agreed with Herbert Spencer that science can know nothing of first causes, and insisted that nothing would ever be known of them.

> They [first causes] cannot, as Stanley Jevons has supposed, be inferred from any branch of scientific investigation, and where we see them asserted we may be quite sure they mark a permanent or temporary limit of knowledge. We are either inferring something in the beyond of sense-impression, where knowledge and inference are meaningless words, or we are implying ignorance within the sphere of knowledge, in which cases it is more honest to say: "Here, for the present, our ignorance begins," than, "Here is a first cause." [1]

Spencer believed that nothing would ever be learned of the cause of motion, or of the nature of matter, or of the process of delivering momentum, but he was incorrect in denying this specific knowledge to man. He even went so far as to assert his own knowledge of the limits of knowledge, his own understanding of the possibilities of understanding. He believed himself able to locate the borders beyond which the unknowable regions lie.

Now we have never been able to account for the Begin-

[1] Karl Pearson: *The Grammar of Science*, pp. 152–3.

ning, but this fact should not hinder the study of what is now happening. Despite what Spencer and Pearson have said, we may finally understand the nature of matter, of motion, of momentum, and the relationships of matter and mind so far as they affect us. Indeed, we may sufficiently comprehend the problems of our physical lives to direct them adequately. Such is the nobler object of philosophy.

Professor Pearson was right when he said of Newton's law of gravitation that it is not a law which planets *must* obey, for "Such laws merely describe, they never *explain* the routine of our perceptions, the sense-impression we project into an 'outside world'." He again remarked: "Science . . . . takes the universe of perceptions as it finds it, and endeavours briefly to describe it. It asserts no perpetual reality for its own shorthand." [1]

The fruitful scientific method has been devoted chiefly to the formulation of the sensed relationships discovered through certain types of experience. Mathematical equations have been arranged so as to apply as correctly as possible to the imperfectly interpreted mechanical routine. The usual formula is not a product of pure reason, but is set up by mind-power associated as closely as possible with appreciable events, and through somewhat crude and incomplete observations of these events. The unit influence promoting sense-data cannot be distinguished through experience, and their exact beginnings and endings cannot be identified. Thus vagueness necessarily distorts the formulations. However, the apple falls from the tree many times and we not only predict another fall but even formulate its expected average motion through gross space and time. Convenient and fairly dependable patterns have thus been cut from generalized experience. Yet these outline-formulas refer merely to composite events that *seem* always to be repeated under similar circumstances.

The mind, however, may perhaps understand something of the fundamental or unit principle. That is, it may get a glimpse of that which causes and conditions the particularities composing the gross experiences.

[1] *Ibid.*, p. 216.

And, too, whereas we may never be able to understand the cause that created our Creator, this does not prevent us from understanding the causative powers of that which now operates in this universe with the Will that Schopenhauer describes—and with purpose besides. We may use our reasoning minds to analyze and interpret the effects created by similar powers operating generally; and when we have attained a sufficient mental strength, and have also used general reasoning sufficiently, we may perhaps know not a little about the unit quantities of matter, of motion, and of force—and also something of that Evolution which appears to be accomplishing with matter purely a mental Purpose. We shall know enough, perhaps, to formulate the mechanical routine incident to the processes of Evolution. We may even be able to inject the human will as an ingredient in the mixture. We may then even importantly control some of the terms of the environment which particularly concerns us. When we attain this mastery of matter we shall no longer be its slave.

Schopenhauer incorrectly believed that "each part of the universal Will—each species, each organism, each organ—is irrevocably determined by the whole." Yet his philosophy of human behavior contradicted this opinion. How could he think this and preach a system for self-improvement? Facing the determinism that he calls for, what is the meaning of his "Will-to-live?" What, too, is this wisdom which he says has such powers that "Of ten things that annoy us, nine would not be able to do so, if we understood them thoroughly in their causes?"

The first step towards our mastery of the physical environment is surely that of conceiving properly the natures of matter and mind, and the attributes and possibilities of each. Our mind-power, our mental freedom (meaning here by "freedom" that principle which our mind-power exercises in a fashion independent of mechanical laws), can accomplish something beyond compiling laws of the normal physical relationships. It can reason, and it can also understand the reason symbolized in the motions of matter: It can act independently in respect of matter: It can originate mechani-

cal motions: The human mind can also appreciate its physical environment and can partly control it. This, however, is not its entire range of action. An emotion, as Professor William James asserts, may be derived chiefly from the experience of a bodily change. A child may not cry because it is afraid, but may be afraid because it cries. Yet, even though motion may often seem to be traceable to a relationship involving a physical activity, more than bodily changes of physical structures cause it. One does not begin to cry until a mental judgment has acted to interpret the effect of the physical changes which later give rise to the emotions of fear. The mind can take judgments of the relationship of the physical life with the mental life. In all such relationship the mind's role is subjective.

Infirmity alone now prevents the human mind from accomplishing more with matter. The physical energy-movements (mind-created, it is true) still dictate the most important terms to human life. Yet, Schopenhauer, after denying possibility of accomplishment to the will of the individual, later attributes to the general will a complete and final authority over a man's body-organism. "The action of the body," he writes, "is nothing but the act of the will objectified. This is true of every movement of the body. . . . The whole nervous system constitutes the antennæ of the will, which it stretches within and without."

Both these extremes are untrue of the man of to-day. We are still largely physical, but, when our conscious mental power becomes finer and stronger it will pass beyond mere pattern-making. It will then control more of its physical relationships. It may fail only when it attempts to understand the cause of its own being, and will perhaps fail in its purpose only when it tries to overrule the processes planned by the universal Power. When the perfected mind of man—if such evolutionary progress is indeed possible—shall have comprehended its pure self, when it shall itself have become pure, it will be an understanding and creating power indeed! It will halt perhaps only before the cause and creation of itself.

Professor Joad says:

> Our conclusion is, then, that mind is essentially different in character from matter. Its qualities and attributes are different, it belongs to a different system of causation, and it fails to exhibit any necessary correspondence between its own variations in *quality* and the purely *quantitative* variations of order and arrangement of which alone matter is susceptible.[1]

Professor Pearson, like many others, denies that an exterior will, or universal mind-power, might be a first cause of motion, and thus, indirectly, a cause of sensations mentally appreciable by human consciousness. He thus virtually denies that consciousness, in appreciating the sensations derived from motions, is indirectly appreciating something like that which the mind might itself purposefully create. He is left, therefore, without a hint as to how the mind of man either conceives its physical surroundings, or comes into relationship with them. He endeavours to prove dialectically that Schopenhauer's belief, that general mind-power, or Will, is the cause of all phenomena, is improperly founded.

Certainly, the philosophy of Schopenhauer is open to criticism. After ascribing unlimited power to the universal Will, Schopenhauer denies the possibility of accomplishment by it, and therefore virtually denies its reality. He says:

> The true philosophy of history lies in perceiving that, in all the endless changes and motley complexity of events, it is only the self-same unchangeable being that is before us, which today pursues the same ends as it did yesterday—and ever will.

Professor John Dewey, also, seems to conceive that mind-power is physically founded. He regards mind as somewhat separated from ordinary substance, perhaps, yet as a principle still physically related, a refined or "psycho-physical" something, as he terms it, that results from changes in the associations and forms of certain characters which nevertheless remain fundamentally physical. Professor Dewey acknowledges evolution of a kind, and accepts it as an influence both upon the physical world and upon the life-organ-

[1] C. E. M. Joad: *Mind and Matter*, p. 75.

ism, but he nevertheless seems to regard mind as a shade of development *within* matter. If he had reversed his concept, viewing matter as a particular arrangement of the mental essence, and had conceived of Evolution as resulting from the disruption of material particles, unit by unit,—a dissolution followed by the apparent creation of the typically mental powers and qualities,—he might have clarified the subject. Thus he might have explained life and nature more as they are.

I agree with Professor Joad that reason seems to justify us in holding that:

> No possible arrangements of the electrons and nuclei known to the physicists can account for and determine the qualities of mind; and they cannot in our view do this for the reason that these qualities are of an entirely different character from anything that is known to the world either of physics or of physiology. [1]

It would be too great a task to distinguish between the respective conceptions of Professor Dewey and Professor Pearson. They (like Spencer and Kant) start with different premises and reach different conclusions. Neither has our concept of the inner nature of matter, nor our ideas of what Evolution signifies. Neither acknowledges that the human will might make matter move over a path that would never have then been taken had there been no mind possessing powers separate and distinct from those exhibited by matter. Neither imagines what might happen in an "absolute" sense in a miniature universe that consists of one man with two objects in reach of him. Each would probably claim that immediately after the creation of this universe the man could not make these objects move. Each would assert that the very desire and power to cause motion result as continuations of a previous physical process—and are therefore disguised mechanical principles. They might agree with Professor James that a physical activity precedes every mental emotion, and might accept this as proving that the mental quality is physically natured. Neither would agree, probably,

[1] *Ibid.*, p. 73.

that an impulse to action might arise in this man *from the very unique and completely non-material nature of the mental power* which existed in him *at the time* of his creation, the presence and abilities of which have alone served to distinguish him as living rather than dead matter. And neither considers the possibility that, in the cases when the physical activity does (by virtue of *the* motion purposefully *given* to matter) create the mental emotion, so to speak, this happening does not leave matter after the act as the subjective reality, but rather signifies the transformation of the physical principle into a mental character altogether different and unrelated. Matter is objectively related to the motion given to it, and this motion creates the change in the physical arrangement whereby even the objective properties of matter are sometimes destroyed.

The psycho-physical is regarded as merely one stage (but, to Dewey, a different stage) in a continuing process which has its source, routine, ending, and continuing reality in something always physical. Man, the mechanists say, has no purposive driving-force typically independent of those physical impulses remaining unsettled from old experiences and contacts. In a universe suddenly formed of a man and two particles, and with no past history containing within it a physical momentum leading in the direction of this certain mechanical act, the man would doubtless find himself quite unable to move the particles in front of him.

Evolution of every kind is described by many materialists as the chance-creation of physical processes. It may be nothing more, some think, than the general change due to the expected steady increase of entropy. The ending is merely a new and accidental, or incidental, physical arrangement. Mind-power is regarded not as something distinct in quality from matter, but as a unique type of matter—a psycho-physical something which merely happened to appear as an ingredient in a universe rearranging its physical self, perhaps, in terms of a steady reduction of the average energy-potential. They admit, perhaps, that this mind-power, this psycho-physical combination of a new sort, can manifest a more subtle influence than ordinary matter in motion, but even then, they

assert, both this influence and the life proceeding from it are still to be regarded as physical off-shoots.

Change is thus supposed to be able to appear from the depths of the natural passivity of matter, and the process and product are supposed to harmonize perfectly with Conservation, for both, it is claimed, exemplify nothing but the expected physical re-combinations. The mind-power is thus regarded as a development from the (in the average) invariable totality of the motions of matter. The somewhat unique mental quality is still physical. It is a unique physical presentation. It is so material, indeed, that if it suddenly appeared in a perfectly balanced mechanical situation it would have no ability to express a volition that would add a motion in any way deviating in time or space from the normal mechanical routine. According to this view only if the man of the miniature universe had experienced previous contacts with the physical world through which certain types of mental powers and volitions happened to be developed and stored in him in mechanical terms, could he thus exercise a will to move (according to what only *seems* to be his independent volition) the matter in reach of him. Hence, so the materialists claim, his mentally directed activity represents nothing more important than a unique manifestation of the mechanical principle. It *must* cause a certain result in a certain way and in a certain direction—in a way that corresponds with mechanical determinism.

Some believe that no single motion, or choice of the time or direction in which the motion takes place, is independent of the physical past. The psycho-physical power may now be able to move matter, it is true (and some agree, without carrying the implications further, that the mind even has a certain kind of purpose and choice in the selection of the one appropriate action out of many that may be possible), but the purpose and choice, the materialists think, come entirely from, and are fashioned by, previous physical experiences, and do not illustrate unmechanical principles. How, they ask, can anything which is not physical come out of the physical? And yet, let us ask in turn, how can time and direction be independently chosen and introduced into the mechanical

routine without breaching the mechanical sequence as dictated by the purely mechanical terms? Such a breach exemplifies free-will—not pure mechanism!

The important questions, then, are these: First, how do we define matter? Secondly, can these typical physical attributes as called for by the definition be destroyed by a sufficient motion and rearrangement? And, lastly, can a non-material quality present itself so as to affect the typical mechanical routine (through an exercise of choice) and thus exhibit qualities which are neither inertia nor inelasticity? Most writers do not attempt to answer these questions. Nevertheless, as we have said, some acknowledge both the process of change and the fact of "choice." The bias of choice, they say, comes as an inheritance from the physical past, or, tracing back to the ultimate, both Change and Choice come from the cause of the Beginning, and, thereafter, reach us in strictly mechanical descent. The unknowable "Absolute" seems to be the cause of this mysteriously continuing Change, and this reaching back to infinity for the explanation of that which now happens from minute to minute, seems to satisfy them.

Mind-power as defined by the stricter materialists is a property of the inert physical which can neither be described nor comprehended. It is an electron which somehow is not an electron. A peculiar activity is supposed to be derived in some way from a form of matter which, by its definition, if left at rest will remain motionless. The electron is supposed somehow to be able to attain new traits, but we are not told whether at the same time it loses any of its old ones. If the admission were made that the electron lost all of its material properties at the time that it began to exhibit its distinctly mental traits, we would be inclined to accept this statement and its implications. This, however, is not at all the belief of the materialists.

We are willing to admit that mind-power *would* not exist in a man unless a previous contact of matter-particles in his body *had* caused the mental essence to appear in him; but, after a man *does* exist as a living organism (after matter has been transformed to supply him with mind), we assert

that his mental character then represents something distinct from substance. He then has the power to act according to mental standards, according to living powers partly independent of mechanical necessity.

Unless there are in association fuel, water, a boiler and an engine, and in addition to all these the essence which, by analogy, we may term the spiritual power of heat with its planned Evolution, there would be no steam in the cylinders, and the engine would be unable to operate. The engine, however, would then be dead, and would not represent the significance of an engine. The fly-wheel could not turn over; and motion would not be in evidence. The phrase "steam-engine" is inappropriate unless the power of *action* is granted. On other terms the engine is merely an aggregation of motionless substances. Before the power of steam exists in the mechanism it is not a dualism—not the activity of steam plus the inertia of matter—but is merely inertia. And, after the steam has appeared in the cylinders, the new powers (according to the terms of our analogy) are actual and *will be expressed* in harmony with the quality of the new principle.

Similarly, if a mental or vital force is assumed to exist in the man who forms the living part of the miniature universe, then, regardless of the past physical relations which created him, he must be granted the ability to express the distinct quality of his own different principle. To be sure, like the compressed steam in the engine, the force of him might act only once unless an additional supply of driving power was created thereafter by a continuing Evolution of matter into mind, but, just as the power of the steam *can* act this once, can express its own typical power without regard to future or past happenings in other quality-realms, the man, likewise, can certainly express his mental power without reference to the normal mechanical routine.

The distinctive mental principle is not present as a reality unless it has the distinctive ability to do something in reference to the world of matter. And, we must admit, too, that, in the universe consisting of a living man and two motionless particles of matter, any independent motion cre-

ated by the will-power of the man introduces a revolutionary principle, a result entirely independent of the normal mechanical routine. If mind-power is distinctive in quality from matter in its ability to create motion independently,—that is, if it can move matter in accord with its own choice and selected direction and time,—then such a mentally created motion is "absolute" in respect of mechanics, and is contrary to the Conservation principle.

Professor Dewey admits change, the change caused by rearrangement, and the rearrangement caused by motion. But what causes the particular type of motion? What causes the reversed cycles everywhere? There's the rub. Motion is not attributed to the activity of a universal mind having its will with matter and purposefully moving it. Rather (at least so Professor Dewey asserts) the cause of change, the cause of motion, the primary cause of movement, is unknowable. In this view he agrees with Herbert Spencer; but here an admission is made which must be taken as indicating a fundamental weakness of the philosophy.

Professor Dewey thinks that no principle must necessarily be identified with change *as it occurs*. He thinks that change can take place without the presence of an "absolute" and non-material power. To us it would appear that such Change results from a quite incomprehensible process of alteration in a mixture. Both the cause and the law of "spontaneous" Change are unknown and unknowable. In one sense such Change is even unreal, for its alteration subscribes to no "necessary" principle. The process, as thus described, is not supposed to be obtained from a momentum inherited from the past and now real in the present. The change is not supposed to be analogous to the separating motions of particles shot from a gun in one direction at the time of creation. It is not like this, as Professor Dewey says, and cannot thus be explained. He views Change more as a series of "spontaneous" explosions due to powers now, for an unknown reason, being expressed for the first time.

The more subtle mechanical qualities derived from matter by Change—one of which is mind-power—have the ability, according to Professor Dewey, to choose from haphazard

events (as though events could be haphazard if mechanically determined?)—events which are more than the heights or depths of the waves in the stream of change—and rather part of the flow itself. They thus alter, and, with their own new mechanical principles, create future experience. The psycho-physical power has somehow acquired the power to influence the changing process by which it was derived, and, through judgment (which to most people appears to be a purely mental character, with nothing of the physical in it) of enough experiences, has learned to select a better course for future experiences. We are not given the limits of the powers attributable to this psycho-physical stuff but are asked to think of the continuations of Change, even in its larger aspect as a physically self-perpetuated and a mechanically self-created process. The mind, although still matter, somehow lifts itself mechanically along the route of Change. And yet, while this route is being followed, without bent, momentum, or necessity, not only does matter remain changeless as a whole, but mind remains completely physical in its definition.

For some unknown reason, and in an unknown way, a single essence, beginning as crudely physical matter, such thinkers assert, has developed within and from itself a process of change. This process displays no *élan vital* such as M. Bergson describes. Indeed, matter is not influenced from the outside,—as some have believed, but is described as a self-contained, self-functioning, and self-developing system. Possessing this mysterious ability to create change as one of its attributes, a cause and yet not a cause, a process has arisen (its arising, they insist, having neither influence nor source of power outside of itself) *within matter;* and, by means of it, the unique psycho-physical character has appeared—and is re-appearing in new forms.

This, in brief, is the conception. I believe these thinkers have reached this unreasonable pass because they have realized no means by which mind-power might at once be distinct from matter and yet be associated with it. They can find no place for mind-power as a separate entity, with distinguishing attributes, exclusive qualities, a distinctive

definition, and with powers over matter. Yet, just such a separation and opposition of quality might well arise from nothing more remarkable than the sort of re-arrangment of substance (by which the significance of the substance-quality itself is destroyed) which might well come from mentally empowered motions and collisions.

Professor Dewey admits a certain distinction between the purely physical and psycho-physical; but he does not finally admit their real separateness in significant quality and definition—a difference as significant as that separating inertia and no inertia. He balks at this concession of a real dualism, and takes this stand seemingly because of a belief that on making this admission he would be unable to explain the undoubted association of the two principles. He therefore sees mind as a remarkable and mysteriously endowed physical arrangement. He does not grant mind the separate and disconnected power and quality that we call for. He does not define it as something so different from matter that it can make matter move with independent and purely mental purpose. If he had done this, he (and others also) might be willing to admit that in the quiet world consisting of a newly created man and two particles of matter the man not only could make the particles move in "absolute" fashion, but *would* do so. The man *must* create motion if he is to make use of his mind-power—if his mind-power is to escape from the limiting restrictions of his physical body-organism. Otherwise, like compressed steam, which, when it is confined in the cylinders, refuses to push the pistons of the engine, this vital power would be obliged to spend all of its purposeless life within the cold and motionless environment of a dead mechanism.

Professor Dewey admits, to be sure, that ordinary physical matter does not contain wisdom, experience, or law; and he agrees, too, that the use of mental judgment (and it alone) is followed by an activity based upon judgment. He agrees that mind-power can change the reality of the future by directing conduct along mentally selected paths. Mind-power in association with matter make up the reality that composes and even adjusts experience. In addition to this, however,

we are contending that mental power is fundamentally distinct from matter, that it is able to be independent of past mechanical events. It can cause purposed movement, and it can create change independently. It can thus mould a future different from that to be derived from a world mechanically determined. The principle of ethics may even be disclosed in that conduct which provides the most perfect physical adaptation of the species with the average manifestation of the physical environment.

The ability of the mental power to judge of past mechanical experiences is one proof, as we have said, of its independent reality. And, let us note also, that, at the time that a mental power seems to be restoring a necessary equilibrium in an organism, it may be overriding some other mechanical routine that is even more "necessary" when viewed from the standpoint of pure materialism than this particular routine established primarily for the benefit of the particular organism. When a man builds a fire in the furnace he may improve his bodily temperature and health, but the fire, in time, will completely destroy the iron atoms composing the grate bars. We must also realize that the activities of the mind are not limited to material considerations. They are not altogether derived from the mechanical impressions of the moment. They may even be devoted to purely mental introspection, to fields unassociated with substance and its immediate "sensational" relationships, and to what the mystic calls "recognition" of one's self. The less acute the problem of the body is, the more may its mind-power consider relationships outside of mechanics.

Because Professor Dewey perceives mind-power and matter as associates in experience—and even as associates in creating *future* experiences—he denies that matter is completely separated from mind as Bishop Berkeley claimed. To some extent he even denies the parallelism of mind with matter as asserted by Hume and Locke. He objects with vigour to the idea that the physical world might be a mental creation, and that external matter is mentally unknowable. Yet, because he believes that all knowledge comes directly from specific sensational experiences,—that is, from the

direct associations of mind with matter,—he thinks it absurd to use this experienced association, or the product of it, as an instrument for proclaiming that the association is impossible and unreal. He asserts that it is impossible to believe that the mental character has no part in creating physical experience. We certainly can agree with this last statement, but we interpret it differently.

In every experience with physical nature, man *may* exercise choice selective as to direction and time, and this fact is sufficient proof of the independent reality of mind-power. Granting to mind this ability to "choose," it can no longer be defined in strict mechanical terms.

Professor Dewey says: "Choice that is disguised or denied is the source of those astounding differences of philosophic belief that startle the beginner and that become the plaything of the expert."

It must be granted, then, that there *is* a possibility of variations in the general experience as created by the general Will. We contend that man's mind can seize upon this possibility and make use of it. He can use his own choice to discriminate between the possible experiences open to him through the circumstance of the general variations and irregularities in the mechanical whole, and he can use his own unique power (to a certain degree, at least) to plan, to arrange, and to direct the intimate details of the specific event that he prefers. The variations in the mechanical situation as a whole, the general motions (which we may discover yielding somewhat to a localized directioning), are products of the general activity of a non-material principle active with matter. Nevertheless, the power of choice is real as an attribute of the human mind because man *does* have some ability to control (and also to re-arrange somewhat according to his individual preference) this general routine which has been created and arranged in general terms by the general Will. The power to create routine, and then to change it, to change it or create it along purposeful lines, to change it or create it according to volition, and not according to mechanical laws, is present even in man, and is being actively expressed by him. A piece of matter

at rest cannot move itself. Nor can it ordain the movements of other matter-bodies according to a choice based upon judgment or volition. And still other reasons are given elsewhere that establish the significant differences between a mechanical blow and the thought arising from it.

Speaking of the stabilized and fixed universe as imagined by Aristotle, Professor Dewey remarks: "Perhaps it is a caricature to say that the ultimate of reason is held to be the ability to behold nature as a complete mechanism which generates and sustains the beholding of the mechanism."

Except for the presence of change there would be no possibility of the exercise of choice, and hence no exercise of mental power with regard to physical relations. Change, therefore, stands for something importantly different from mechanically determined routine. In order to have change and choice (at least change and choice of the types that this world affords) something must be created within the moment by an independent Power that expresses itself within that interval. And, the difference between the new condition and the old subscribes, in general terms at least, to the *principle* of that which causes the change. One of the principles behind change, if the universe is organized by a mental power, is Purpose. Change, then, signifies the presence of both Purpose and Power. We must therefore postulate for the universe the reality of an active volitional Power, or vital principle, or whatever one wishes to call this Cause which exercises an independent ability to give motion to matter for the purpose of accomplishing its plan.

This reasoning seems to suit human minds, for, if the evolutionary changes in mechanical formations are caused by a universal mind-power it is not at all remarkable that human minds are able to perceive the changes, the unusual energy-situations as thus created, the new mechanical directions, and also some of their necessary effects in universal and in individual relationships. It is therefore not remarkable that the human mind itself exercises choice in a relatively weak but real power over matter, and creates its own change—one which in some respects may even overrule (in

the sense of arranging anew) the routine previously arranged by more general Power.

Professor Dewey does not admit that the cause of Evolution is a purposeful external mental power altogether different from matter—a power that is always present, universal, and somewhat similar to that which arises in man. Rather, he says, when it happens that this psycho-physical character is formed in the conglomerate of the universe, it expresses itself, and new conditions are thus caused to appear. They seem to be revealed through some self-induced process, or perhaps as the result of new and completely fortuitous combinations (or motions) of substance, one of which is this psycho-physical substance never before disclosed.

The emphasis of Professor Dewey on change is well founded, and this change is indeed "absolute." Nor has he failed to emphasize the fact that matter is knowable by this psycho-physical mind that he describes. He agrees also that "normal" substance is somewhat different from mind; he even argues that, on account of this quality-difference, new experiences can develop from the repeated associations of gross substance with psycho-physical substance.

Yet Kant was right in saying that exterior matter—universal substance with nothing but inertia as an attribute—is not recognized ever by being "sensed" directly by mind. The active mind and the inert heart of the smallest particle are too separate for this. The human mind is immersed in its body, and sensations from exterior matter, except in rare cases, seem to reach the mind only through the medium of this body. The motion-quality of a blow, however, is not, after all, a material character passed on from one energy-volume to another, but is rather a mental "charge" of will. The physical universe makes its qualities known to the mind, not by contact of physique with physique, as though the mind were the same principle as the body from which it emanates, but because these mentally caused blows at times result in mental creations within the body-organism, and also because the physical organism of the body is changed by these energy-deliveries and is subject to a different mental subjective interpretation, and also, finally, because the

mind-power recognizes the relationships of inert bodies as and when it subjectively gives motion to them.

Professor Dewey, it seems to me, therefore, errs when he denies that the observed changes might be attributed to mental powers with non-material properties. The mental power inducing change is not an inheritance from a first cause, but it is a vital principle which at present exists and acts. The day-to-day changes are caused by it. The important attribute of mind-power is its non-material activity, constantly expressed, which manifests itself significantly by creating this continuing change. The primary cause of general mechanical events, then, is a character similar in type to the human mind-power.

Mind and matter are definitely separate. The distinction between them is clearly marked. None of the material quality of inertia seems to belong to the mental, and no power of voluntary motion is to be discovered in the physical. Mind alone has purpose. Rather than quality-association of the two, or conceivable quality-relationships, or such phenomena as material barnacles clinging to mind, there is a sufficiently perfect quality-opposition for our definitions to separate them distinctly. Their recognizable attributes do not overlap. We perceive their separateness and realize their respective qualities as and to the extent that the proportions of activity (purpose) and inertia (purposelessness) appear.

Nor does Professor Dewey seem to attribute sufficiently to mind-power its privately owned attribute, its own essential wisdom, together with the power (and desire also) to accomplish its plan. What use, pray, is the possession of reason and the power of choice without the complementary power of causing independent and, therefore, "absolute" motion? Yet, who will deny that mind-power possesses purpose and directive choice, or will assert that matter possesses such attributes? This purpose would be vain and useless in this universe of physical sensations unless there were associated with it both the power to rearrange matter, and the matter within its reach to be rearranged.

Matter *cannot* equal mind qualitatively. It is inconceivable that activities should be promoted without accomplish-

ment in terms of that which activates. A dualism of arrangement is implied, therefore, in every concept that embraces a changing and evolving quality of life—a life made real to us by the motions of matter which reach and create mind-power within us.

We come, then, with positive assurance to the last attribute of mind-power. Mind can and does make matter move in a fashion that even regulates mechanics. Count Keyserling truly said:

> As mind, I influence matter; in principle there is no difference between the most ordinary gesture of the moment and the miracle which the magician may perform. [1]

And Professor Joad with equal truth declares:

> The conclusion seems to be first, that by no possible combination of physiological states can we account for *all* the variations and modifications of mental states, and secondly, that physiological states can in any event only produce quantitative changes of a greater or less degree of intensity of emotion of the same sort, and are unable to account for qualitative changes between emotions of different sorts. [2]

Theory requires, however, factual proof of its validity, hence I shall later use the principles of physics in an attempt to prove that relative motion *is* being destroyed. This, indeed, is perhaps the most important step in this book. If this "absolute" destruction of energy can be proved, then, because of the unceasing motions of matter, we must accept as real the presence of a Power which from moment to moment makes otherwise motionless substance move. I shall, however, before I consider these important principles of physics, represent by a rather long analogy the separate realities of mind and matter.

Let us imagine that steam is the active *spiritual* arrange-

[1] Count Herman Keyserling: *The Travel Diary of a Philosopher,* Vol. I, p. 317.

[2] C. E. M. Joad: *Mind and Matter,* pp. 72–3.

ment and agency, the very opposite of inert, *physical* water, and that the attribute which makes steam active and potent is an intangible, etherial, even spiritual, heat. Steam, we shall assume, may be represented as if it were a non-material heat itself. Because of its heat it can add temperature to water up to the point that the water turns into steam. According to our assumption, the water-essence without heat is characteristically materialistic, cold, and sluggish. As temperature is added, its particles move backward and forward faster and faster until finally they reach the critical point where the water-structure instantly becomes steam.

The qualities of hot, active, invisible steam are (by assumption) in every way opposed to those of cold and inert water. When water is completely cold and quiet, when in its ultimate of inertia, when uninfluenced by heat, it may be called ice. The gaseous steam is likened to mind-power; whereas the ice of our assumption, without motion of its parts, without any attributes of heat—if there were any such composite body in nature—would represent absolutely cold and completely solid substance. Let us not attempt to describe the imagined inertness of such ice, however, for the inner structure and quality of that which never moves can never be known to the direct experience of anything outside of itself. The heart of the one cold solid, the smallest bit of matter, is isolated to experience. Only reason can determine its essential composition in the light of that which it does (and even becomes) when sufficiently moved by a mental purpose.

In the presence of active, purposeful steam, this inert ice will not remain unmoved. First it will be converted into a fluid, and then the ponderable liquid will by degrees be converted into imponderable steam. The life-experiences, the sensations to be derived from the heat of the moving water, and from the evolution of the water caused by this heat-process, come from motion. When steam adds heat to water with "absolute" power, the latter then becomes potent, so to speak, and moves, and affects. It finally reaches the steam-quality by turning into steam, and in this way its motion-qualities, displayed in proportion to the heat it pos-

sesses, become significant. All the grades of the properties possible to the water—the changes in its fluidity, colour, density, in fact all its recognizable features—are expressed in proportion to the motion given the matter-particles by heat. And these properties are recognizable by the newly created steam because it is intimately associated with the fluid as it brushes aside the inertia of the water-particles in its escape to freedom.

Where, then, when the water has been transformed into invisible steam, have the attributes of water gone? Whither have the liquid characteristics vanished? Yet, were not these characters (as recognized through experience) due to combinations of matter and heat-motions? Where in the spiritual steam may be discovered the motions of the fluid—those movements which were possessed by the inert particles of matter solely because the heat had made them thus move? Where are these former mechanical forces as represented solely by inertia in motion? To be sure, they no longer exist, for this inertia, after all, was a secondary quality, and it disappears as the water disappears. Even the motion-factor of mechanics may be secondary, and disappear.

Some might say that the inertia of water is a permanent reality, even if its motions may not endure. Is this possible, however, if, according to our assumption, the steam into which the water is transformed has no inertia-quality. Only the essence composing the water is finally real in the steam —and since this essence, now appearing as the spiritual element (the steam of our analogy), is imponderable, the qualities of inertia or ponderosity in the water must be secondary. Although the water-particles may seem steadfastly to occupy a dependable space-volume, certain particles, as converted into steam moment by moment, unquestionably surrender their exclusive possession of space, and are therefore completely and instantly losing that inertia which we incline to regard as steadfast. Inertia need be only a temporary attribute of the arrangement which displays it, for the material arrangement may itself be destroyed. Not substance but spirit, not matter but mind-power, is permanently real!

The heat of the spiritual steam, then, is discovered as

the cause and the composing reality of all the expressiveness ever displayed, of all the motions ever appearing, of all the activity which carries out a purpose, of all the essence which, even after Evolution, continues to exist. Life-experiences arise, apparently, from the purposed activities created by the cause of motion. Indeed, when viewed from the standpoint of substance the spiritual power seems to have no other purpose than that of transforming the material fluid of the universe into its mental self. All else is secondary to this.

If this be the purpose, what is the method of accomplishing it? If the transformation of water into steam (of matter into mind), be the revealed plan and willed activity of the directing Cause, how, might one think, would a reasoning power proceed to carry out this plan most effectively? Let us consider the necessities, for they may help explain our world.

The steam must heat the water-particles and evaporate them. It must give them heat-motions; and it must, by continuing the motions, bring these bodies into collisions one with the other so that the heat-motion may be passed on and perpetuated in the face of energy-cancelling collisions. The material arrangement may thus finally and gradually be broken apart. This may be the purpose and the possibility. How, then, can the plan best be achieved? When heat is added to the water-particles they begin energetically to move in straight lines and thus tend to separate indefinitely. How, then, can they be most efficiently brought into repeatedly recurring collisions at high speed?

To heat water efficiently it must be confined in a volume as compact as the heat-movement of the water-particles and the strength of the container permit—and then heat-motions must be added. In respect of the wide universe, however, what power may constrain the elements into compact volumes while being moved? Surely the force of the universal Will is such a power. Just as it has the ability to make the particles move and separate with a purpose, so also it must have the power to hold them concentrated while moving them and re-creating their movements. The inert water, as we

have said, obeys the will of the spiritual steam. When heated, its parts move faster and faster, but they move only to the permitted bounds. At certain spatial limits a force of reversal obtains. This principle is true of all motions whatever.

The steam that is to heat the water-molecules efficiently must not permit them to separate into infinite space, for there would then be no further relationships of molecules charged with the heat-principle, and no recurring collisions. If the steam acts with reasonableness it will hold the water-particles compressed into a volume wherein the separated particles will remain in as close relation as the energies of their renewed motions will permit.

Here, in this compressed sphere (or cylinder, as Einstein thinks) of the universe of matter within which both matter and energy (as we shall discover) are cancelled without compensations—an equilibrium is established. According to the terms of this equilibrium the average energy of motion, as delivered at bounds to all the matter-particles arriving there, is the same as the energy delivered to these particles at the opposite bounds. Also the energy that is expressed by these particles within the sphere against any area, when averaged grossly as to space and time, is one constant amount in certain parts of the sphere. The same principle is evidenced in every fluid volume.

A balance is thus reached between energetic motions in opposite directions; between the effective outward drift of the parts and the inwardly compressing force acting against them as they reach the maintained boundaries; between the internally evidenced cycles of heat-motions and the exterior, restraining, and therefore mechanically creative, force of this same heat-principle. This equilibrium may be conceived as existing virtually between two phases of the mind-power itself, between two examples of its purpose. The energy-equilibrium (and the principle of restraint as well) persists even to the maintained boundaries of this sphere of moving bits of matter. Only thus may there be contacts of parts and planned evolutionary change. Only thus may there be reasonableness in the activities of the mental power with

matter. Only thus may the unceasing motions and collisions of matter be justified to mind.

The restraining force (as identified in the limiting container-walls) opposes itself to those energies given by these wall-forces to the material contents. In the general equilibrium thus established (in rather gross terms, to be sure) within and *throughout* the finite energy-volume, each material structure displays its appropriate measure of the energy of motion received at the bounds. The final synthesis of this equilibrium may be summed up as the opposition of the forces of the general (mental) to the inertias of the particulars (material). The forces of the material particulars, however, are not their own. They are bestowed, purposefully, by the forces of the general. In this exhibition of force by matter we may say that only the quality of clinging doggedly to a certain space is possessed intrinsically by the material principle: The motion-part of the mechanical force-phenomenon is a charge of mental quality purposefully given matter by mind for the moment.

The goal of the creative cause appears to be the destruction of the cohesion and inertia of the inner being of the bits of matter. Its accomplishment consists in the creation of motions of particles, and in the restrictions of these motions within definite confines in order that there may be disruptive collisions. Both the general and the particular states of energy-equilibrium (and of the order as exemplified by the large and small cycles of internal motions) follow naturally from these governing conditions. When some of the matter-particles reach the boundaries of the universe, they are halted and reversed (or deflected), and their returning motions again serve to maintain the mechanical energy-field throughout this finite volume.

Not entirely perfect, however, is this energy-equilibrium, for, as we have said, it tends to be weakened in those places where mechanical motions are eliminated by the collisions and dissolutions of the inertias of particles. The pressure is reduced momentarily whenever matter in motion in respect of the universal center of mass is eliminated without com-

pensations, and also whenever the energies of motions of corpuscles are cancelled without compensations.

The Change in the average of the life-experiences as derived from this universe may be attributed to the "absolute" reductions in the quantity of matter. An energy-balance is established, then broken, and then re-established, for motion is always restored to the restrained pool in order that Evolution may proceed. The mass-density of the universe changes, the formations and velocities of its particles alter, but the mechanical energy-volume is always held within finite bounds while the matter-parts are being driven into reversed motions. The Change manifested as these mentally created motions proceed, signifies that there is in the universe constantly less of inertia and more of the spiritual quality. Substance is being converted into Spirit through a planned mental (or spiritual) activity. We participate in this process, and it conditions our lives.

We have spoken of a sphere of water in which all the inertia and coldness of water-particles—as they then existed in the presence of steam—were to be found; and we have said that this sphere was held in bounds by the pressing activities of the purposeful steam. The volume of the sphere will remain as small as it may while complying with the condition that the water-particles move with as much average energy as they do. The particles must move and collide in order that the purposed dissolution of inertia may be accomplished. Spatial relations must be limited; Movements must be reversed; the volume of the whole may be neither too expanded nor too contracted. Only under these planned conditions will the equilibrium of forces be most efficiently maintained and the possibility of accomplishment most reasonably served. And this balance refers, as we perceive, not to matter-masses, but to matter-movements.

Although Evolution may be having its effects, although the water-particles may be disappearing into steam throughout the seething pool, although there may be vortices of disappearance here and there, we must suppose, nevertheless, that the average energies of motion in adjacent volumes throughout are fairly uniform and balanced, for only thus

may the evolutionary processes be carried on most efficiently. Nevertheless, the evolutionary process itself prevents the perfection of the balance. In certain places Evolution proceeds with exceptional rapidity, and there unbalanced motions of a certain type of matter-bodies will be found—even those unbalanced movements necessary to restore the energy-equilibrium that has been disturbed. Concentrating movements take place (at least temporarily, and through certain limited distances) in the direction of these vortices of unusual disappearance, just as the water concentrates in whirls about the suck of a draining pool. Evaporating water leaves behind it a state of energy-vacuum into which the other water will rush.

If the universe were like an evaporating pool we should expect to discover unbalanced movements towards the centers of the denser masses, and it supports our premise that, in gravitation, there seems to be revealed just such a tendency. Gravitational forces (at least, as expressed towards these denser masses) have no equal reflexes; they signify, to begin with, an "absolute" motion and an "absolute" change, and they point always (in their first, or general, tendency, at least) towards the vortices at the centers of the denser masses. If, however, gravitational influences were not finally compensated in other terms, matter would finally be concentrated into an inert, motionless, mass—that which the mental Power does not now permit.

Mechanical energy, as this theory of a general energy-equilibrium indicates, is not limited to the volumes of the denser world-bodies. Between the worlds, tiny and invisible masses must be moving and expressing momenta; but these scattered and necessarily swift-moving bodies have relatively few collisions, and, therefore, relatively few evolutionary transformations. The dissolution of matter, therefore, *is not uniform in respect of space.*

In this analogy we have passed from the relationship of mind with matter into purely physical realms. We have here reached ideas which refer to gravitational problems, planetary orbits, and the like. We shall not pursue these concepts just here longer than to call attention to the facts

proving that an approximate average equilibrium of pressures between adjacent volumes *is* being maintained in the universe—an equilibrium that *would* be perfect except that energy is being cancelled and that Evolution is being accomplished. Indeed this equilibrium *is* perfect when the whole sweep of the universe is averaged, and also when the temporary but repeated gravitational influences are accounted for. When the gravitational changes are compensated, and when the other various energy-cancellations are adjusted by movements, a general energy-equilibrium remains to the large view. Yet an energy-pool like a water-pool may appear quiet as a whole even though its separate particles are hammering back and forth. A large object held in the water receives no *appreciable* impulse from these quickly moving molecules. The separate blows, therefore, are not realized in terms of a large composite mass intruded into these separately tiny energy-relationships. Yet, if some of the water is drawn off permanently, and the remainder whirls about the drain, the force of this uni-directional whirling is realized quickly. This drainage-force is continued in one direction and it is "absolute." It is not compensated in a quickly balanced cycle like the oscillation of the usual water-molecule. It is not the normal energy-expression, but is an unusual one that is unbalanced through extended space and through enduring time. Except for "absolute" Evolution there would be no average Change, either in the average energy-delivery, the average structure, or in the average amount of motion.

The air-molecules, and other far more potent but invisible forces, press up and balance the forces moving earthward from inter-world spaces. This usually unappreciated energy-delivery is not negligible. Indeed it exactly equals the force that holds matter-structures in "cohesion." Approximately equal amounts of energy are received, in the averages of time and space, from every direction. The forces maintaining the general equilibrium, the cohesive forces acting from every direction, are tremendously greater than gravitational energy. A piece of steel is gripped in a vise-like compression from all sides. And, when under this tremendous compulsion, the

particles of the steel express equal counter energies, and these, because the structure of the atoms is expansive to the proper degree, maintain the necessary equilibrium with world-forces. Thus the slender wire rope of a derrick, through the energies of "cohesion" of its parts, is able to balance an enormous gravitational weight. Therefore the unrealized energies causing "cohesions" of structures are distinct from gravitation. The forces of "cohesion" come from outside the structure described as "cohesive." These external forces create the internal movements of the structure in question, and set the limits to these motions as well. The principle which creates the motions and then limits them, is that which we wrongly conceive as a "cohesive" principle within a restrained structure.

These energies that maintain structures are delivered by the repeated momenta of swift, invisible bits of matter. Heat and light deliver energetic blows, and there are doubtless many other unrealized so-called rays capable of restraining the movements of the parts of the atoms. Dr. R. A. Millikan has recently proved that there are universal rays (etheric rays, as he calls them) impinging against the earth from every direction. Thus he writes:

> This meant that we had obtained much more unambiguous and thoroughly quantitative evidence than had before been available for the existence of an extraordinary penetrating radiation, indeed, so hard that, if it came from outside the atmosphere, it required 50 plus 23, or 73 feet of water, the equivalent of more than 6 feet of lead to absorb it entirely.

After proceeding further with his experiments, Dr. Millikan added:

> Our proof, therefore, is now quite definite and unambiguous that there is an extraordinarily hard radiation coming into our atmosphere from outer states. Further, *since at all the altitudes at which we have experimented we find no measurable variation in the intensity of these rays at any time between midday and midnight, we conclude that these rays shoot through space equally in all directions.*[1]

[1] R. A. Millikan, in *Scientific American*, March, 1926.

Dr. Millikan believes that these cosmic rays have a tremendous frequency, about *"ten million times above the octave of optical frequencies to which our eyes respond."* Granting that these and other so-called "rays" deliver compressive and penetrating effects, we might say that the discovery of Dr. Millikan was to be expected by one who accepts the principle that a universal energy-equilibrium is maintained by the motions of matter-particles. Except for the relatively insignificant gravitational forces, there would be a perfect uniformity in the average energy-manifestation between the different parts of the universe. Sir James Jeans, the English scientist, referring to this cosmic ray discovered by Millikan says:

> The amount of the radiation is very great. Even at sea level, where it is least, Millikan and Cameron find that it breaks up about 1.4 atoms in every cubic centimetre of air each second. It must break up millions of atoms in each of our bodies every second and we do not know what its physiological effects may be.
>
> On taking an average through the whole of space, including the vast stretches of internebular space, it seems likely that the highly-penetrating radiation is far more plentiful than stellar light and heat, and so is the most abundant form of radiation in the whole universe.
>
> It is the most penetrating form of radiation known . . . If it is corpuscular, the corpuscles must be moving with very near the velocity of light. . . . The radiation is about of the wave-length needed to break up the proton itself, the smallest and most compact structure known to science.
>
> A quantum of radiation of this wave-length must have energy equal to 0.0015 erg, and so must have a weight of 1.7×10^{-24} grammes. The quantum of highly penetrating radiation has, then, just about the weight, and just about the energy, that would result from a complete hydrogen atom suddenly being annihilated and having all its energy set free as radiation.[1]

And here, we may say, Sir James has given us a description of just about the type of energetic corpuscle that, if our hypothesis is to prove acceptable, must, by its motion and

[1] Sir James Jeans: *The Universe Around Us*, pp. 136–8.

energy, be maintaining the energy-equilibrium of the universe in the spaces between worlds, and that must also create what we erroneously call the "cohesion" of our atomic and molecular structures.

The average velocity of particles in the denser volumes is less than it is in the more diffuse volumes. The particles composing a piece of steel move with less velocity against the surrounding air than the particles of the air move against the steel; but there are many more of the particles of steel delivering momentum. When, however, all the particles of adjacent structures are considered, it will be found that they press with same average energy-expression on each unit area of its surface. Most of these energy-deliveries, however, are so minute and so perfectly balanced in gross, that they are less realized than the separate energy-deliveries of the water-molecules of a stagnant pool. And then, again, when energy-equilibrium is almost perfect as a whole, and especially when composed of tiny units, only the unbalanced pressures are usually realized. Only general reasoning serves to disclose the nature of the minute energies which compose the fairly balanced whole, which, nevertheless, one by one, and for short intervals of space and time, are haphazard and completely unbalanced. Because general reasoning has been inadequate, however, "cohesive" forces have been erroneously interpreted as being due to internal "attractions."

After this further excursion into the nature of the general energy-equilibrium, let us return to the analogy in which a water-pool is compared to the universe. Unless the water was evaporated by heat there would be no change in the *average* energy-state of the pool. Unless the evaporations were unevenly distributed there would be no vortices of concentrating movements. If there were no Evolution we should observe only purposeless oscillations up to the points of collisions. Water-particles, being inert bits of matter, possess no ability to move of themselves, so the expansive motions of the molecules reaching the bounds of the pool would not be stopped nor be reversed unless energies comprised in these limits pressed them back. The force of stoppage and reversal, when we think of it as occurring at the

extreme limits of matter, must therefore be regarded as unmechanical and "absolute," for no mechanical force can act repeatedly with inward influence at the bounds of matter. Only an "absolute" power can continuously reverse motions there, for no other type of power can "create" the required "absolute" energy.

One might assert, of course, that if there were no evolutionary states of unbalance there might still be movements within a limited and finite space. Nothing could prevent a Cause of motion from starting, limiting, and reversing the movements of matter at will. In such cases there would still be a general energy-equilibrium, and there would be movements to and fro with speeds that were less as the densities increased. Everything would be as it now is except there would be no gravitational tendencies to concentration.

A boy can swing his stick back and forth as often as he pleases, even if he strikes nothing. Couldn't the universal Power act in the same manner, and reverse the motions of the earth as many times as it pleases? Even if "attractions" were unreal, why should the earth take a course forever away from the sun? Couldn't the universal power hold the earth in its orbit? And yet, doesn't the motion of the earth, as we are here suggesting, represent the state of affairs to be expected in a material pool in which an evaporating Evolution is being accomplished.?[1] But then let us ask: Is such an Evolution necessary? Might it not be possible that the motions of matter are forever being maintained by a mental Cause which has no regard nor concern for evolutionary changes?

But why these unreal suppositions? Mentally derived motions, or any motions that do not connote purpose, are inconceivable. True, the boy could swing his stick back and forth as many times as he desired, and without accomplishment, but he would not. He would have no such desire.

[1] We are here reaching that theory of the "Equipartition of Energy", stellar and molecular, which Sir James Jeans describes on pages 148–150 of his "The Universe Around Us." Granting this theory of equipartition, as the scientists seem to do, and tracing its implications, and the necessity of admitting the presence of an "absolute" cause of motion and energy, is almost forced upon us.

Purpose is the principal attribute of mental power. This we know from our own nature. The motions of the particles of water one against another, and also against the restraining borders of the pool, *might* continue forever, even if no evaporations into steam were caused thereby, but they *would not,* for no capable power would continue motions without an accomplishment in view. Except for Evolution there would be no motion of the planets, hence it is futile to imagine what might happen if gravitation were suddenly cancelled.

If one is willing to endow the creative Cause with the desire to accomplish something by the seething activities everywhere created by it, the concept of endlessly inherited motions, of forever repeating orbits without accomplishment, and of gravitational forces which neither create nor signify "absolute" Change (whether or not they be derivatives of curved space-time as Einstein assumes), are unreasonable, and are to be denied. No one can contend that motions *are* limited, and hardly anyone will deny Evolution. It seems necessary to admit, therefore, that a purposeful power *does* create "absolute" movements. Universal changes occur which appear to be as definitely planned as those that a man might plan and execute in respect of his own environment.

Now, if our evolutionary thesis is sound, the dissolution of matter will continue so long as a Purpose is being satisfied thereby. Matter need not and does not endlessly concentrate, however. The "absolute" renewals of the motions of matter prevent this end. Our general theory is supported by the fact that there is a gravitational force which is unaccompanied by general concentration. Indeed it seems likely that a mental Power, after accomplishing its evolutionary purpose with some of the material particles, might separate even farther those that remained. A man can throw a lighter weight with greater velocity than a heavier one, and, if the strength of the man increased as the weight decreased, the velocity might be increased faster than in a proportion to the reduction of mass. The average structural formation of matter may thus tend to expand. The spirals in the heavens may indicate dissipations rather than convergencies.

Returning, however, to the principle of universal energy-equilibrium, we have claimed that the particles in the open spaces between worlds—where matter is thinly diffused—must move with sufficient velocity to compensate for the average reduction in frequency of delivering energy. Their average direction of motion and their average velocity in that direction, must be such as are required to maintain the average energy-equilibrium of the universe.

It is not easy to illustrate this principle through the analogy of a pool of water, for, throughout the pool, the densities and average motions are approximately uniform. Let us suppose that we fasten several inflated rubber balloons under the surface of water. The pool will then be composed of unequal densities—the water being denser than the air-volumes—but there will still be a perfection of pressure-equilibrium throughout. This balance of energies between volumes of unequal densities is maintained by the swifter movements of the molecules in the less dense volumes. The air-molecules, although there are fewer of them, impinge against the partition wall with as much delivered momentum on each square inch, in the averages of space and time, as the larger number of molecules of water. Nothing else is possible if, in the average, the balloon neither expands, contracts, nor moves. In this illustration, of course, we have neglected the possibility of evaporation, and have also disregarded the unbalanced gravitational pressure acting upon both water and air. Nor have we felt it necessary to consider the possibility of molecular attractions or repulsions.

The reasoning that demands the presence of a general energy-equilibrium is important. It compels us to assume that the average free velocities of the masses that are translating energy of motion in one average direction between worlds, bear a definite ratio to the average free velocities of the particles that similarly make the energy-demonstration within the elements of our world.

Indeed, if the universe is both finite and energetic, the relation of the different volumes and velocities of the universe must be consistent with the analogy of the air-balloons in the pool of water. If we knew the velocity of particles

as they moved between worlds, then, from our knowledge of the parts of atoms, we should be able to calculate the average number of particles in each cubic foot of this open space. We should be able to compare the average density of open spaces to world-densities—to the average densities of a piece of lead or iron. Or, knowing the spacings of particles in a certain freely moving body we should be able to state what its average velocity must be as compared to some other freely moving body of equal density. The velocity of the smallest particle of matter as it starts moving away from the bounds of inter-world space towards the general centre of mass should be the maximum velocity which at that time is attainable in the universe. The Power that restrains motions at the bounds of the finite universe must give this velocity to the single particle of matter arriving at these limits, and this velocity is measurable "absolutely" in reference to the centre of the universe. No greater velocity than this can now be. Our theory brings us directly to this conclusion.

Thus far the analogy of the evaporating water in the pool has been used to represent the processes and conditions obtaining in the wide universe. What part of this picture represents that unique little aggregation known as man, in whom consciousness has been so intensified that he has become vaguely aware of himself? This little "forked radish", as Falstaff called him, has come to esteem his own personality, and has begun to worry for fear that this valued something representing himself may be altogether destroyed. He has become self-conscious and troubled. He trembles when he thinks he may be annihilated with all that in him is. With all his self-assurance he is afraid he is not sufficiently important to be preserved. Yet what is this personality to which he wishes to cling through eternity?

We have already used the representation which seems appropriate. It is discovered in a particular phase of the water and steam figure, and we shall extend it further.

Steam, assumed to be the mental or spiritual power of the dualism, is created, and appears within the parts of a power-plant which is so arranged that the escaping vapour drives the parts of the mechanism. The human muscles are

like the driving parts of the engine; the mind is like the steam-power that passes through the engine and operates it; and the human consciousness is like the appreciation by the steam of the structural inertias which must be overcome; while the body from which the man receives his vital forces, is like the water from which the steam arises.

Heat is added to the boiler, and steam is released by the transformation of the water and is led by pipes into the cylinders of the engine. Pistons then move back and forth as the force of the active steam urges the parts so that it may express its will with matter. Finally the steam escapes through the ports of the sliding valves. The vital steam expresses its power over matter and thus obtains for itself a release from this naturally inert mechanism. It here seems to follow the path of least physical resistance. Following this easiest route to freedom the steam operates the engine, and, so long as there is fire under the boiler, and water inside that may turn into steam, the pistons will swish back and forth.

Now the character of a vapour varies with the liquid from which it comes. If mercury is used instead of water, its vapour will be different, and every finely graded change in the liquid will alter the character of the gas that escapes. Every gas created from fluids by heat, however, expresses the same general type of active spiritual power. All expand and press and deliver motion to inert matter and drive it into a life of activity.

The steam, expressing its powers, pushes the pistons back and forth, and the engine runs. The cross-heads click, the crank-shaft oscillates, the valve-ports open and close, the parts wear. Inertia is to be overcome; work is to be done. There are characteristic restrictions and resistances in this engine of which the steam is aware; and this realization is the steam's conscious personality so far as it relates to the physique of this organization, composed, as it is, dually of matter and vapour, of substance and spirit. This personality will persist so long as the activity of the steam persists within the mechanism.

The accomplishment of the power of the engine may

consist of nothing more than the doing of that particular, specialized, selected type of mechanical work as required to obtain fresh coal for the flames, fresh water for the boiler, or new parts for the engine. Thus, in general, the steam is able to prolong the creation of itself. The active purpose and power may be devoted to the carrying on of that evolutionary process which consists of creating active steam from inert water. Indeed, the process might continue indefinitely if fuel were always easily obtained, if lubricant were always available, and if the wearing parts were forever renewed.

When, however, the first leak-hole appears in the boiler, the fire will be extinguished, the water will escape, the steam will no longer hiss into the sky, and the engine, its motions ended, its work done, will no longer be a power mechanism. Within its metal parts there will no longer be a driving and temporarily entangled essence such as steam, and there will no longer be that in it which possesses the consciousness of organized resistances. The power plant will be dead. Its personality will no longer exist. And the active and conscious steam will no longer be freed, moment to moment, into the sky where it may express its power and purpose with a larger universe.

What, then, is the personality of this physical engine-plant?

The engine is not altogether physical. If it were it would have no personality. The consciousness of the dualism comes entirely as a characteristic attribute of the spiritual steam that passes through the mechanism; and this mental consciousness of the steam relates both to itself, to operations and powers of its own kind, and to its relation with the inert but mentally organized matter-forms which it is operating with power and purpose. The steam, restrained by the boiler tubes and mechanical parts, is not only conscious of its own properties, but also, surely, of the work being purposefully done by it against the resistances and restrictions of inertia. Certain material bodies must be moved by its power, and of these the steam is definitely aware. It is being restricted by mechanical "cohesions", inertias, and densities which are both definite and unique, and which the steam

itself must conquer. How can the steam fail to realize the nature and extent of the forces it must use to carry out its purpose? And may the steam not also be fully conscious of its intrinsic nature, even of those qualities which it may express otherwise than in relation to mechanical environment? May it not know too of its origin from the water, and may it not sense directly every change and quality of the water-molecules? May it not also "sense" directly or indirectly the nature of the general external heat-principle which, by adding heat-motion to these molecules, created the steam itself and the steam's heat-principle? And may not the steam know every character which in any way affects itself or its physical associations?

The steam in other power-plants does not have an identical association. Nor do conditions in this one engine remain the same from one moment to the next. All parts of the mechanism are wearing and changing. The heat of the fire varies; the supply of water in the boiler changes momentarily; the iron parts are rusting and abrading; the cross-heads are becoming wobbly. And, unless the wear and tear is constantly restored, the mechanism becomes less and less efficient. The power of the steam must be devoted almost continuously to restoration, or else the bearings will cut, the parts will jamb, the boiler will give way, and the power plant will become impotent and dead. The steam must exercise that particular choice that fits in with its own most successful life-existence.

We perceive that unless the spiritual quality of the steam is devoted largely to the purposeful maintenance of those mentally-chosen conditions which make possible this particular physical personality, the mechanical organization itself will soon become disorganized. It will soon represent no mentally controlled organization as a whole, but only worn rods, bolts, brasses, and old tubes rusting in the junk-heap.

For a certain life-period the steam has the ability to restore the parts and maintain its physical organism adequately. During that period the life-situation may even intensify. In a later chapter I shall attempt to indicate why, at a certain stage, the power of repair becomes insufficient,

and why, therefore, the decays and reduced activities of old age set in.

When there is no longer steam in the cylinders, the engine will no longer have a conscious personality; for there will no longer be a power in it which is consciously accomplishing a specific life-purpose with its organism. The engine will then be as dead and inexpressive as any other piece of inert and mentally unorganized matter. Yet, even this deadness is not necessarily permanent. Here, too, the analogy shows its validity.

If, in a dead power-mechanism, the heat and water are again properly arranged, and if the tubes are connected before rust or wear has gone too far, the steam will again appear, the operation will recommence, and the mechanism, life, and personality of the system will again be real. In like fashion the heart of a person apparently dead may be massaged and the full life and consciousness of that person will reappear. Not only may the personality be thus restored in full measure, but the personality that presents itself will be like that which existed before this temporary death.

If the personality of the steam is traceable to its awareness both of itself and of its environment, and if both may be restored as they were before the fire was extinguished, we should not be surprised that the old personality reappears. The same sort of steam is actuating the same sort of pistons, and is driving the same sort of a mechanical organization. And the steam-power, as started anew, is confronted with the same old wobbles, squeaks, swishes, and resistances. How, then, can this new steam-principle fail to have the old physically-founded consciousness? Does not the fact that such personalities may be stopped and started again afford proof that the steam of our being is in some respects a transient attribute of our bodily mechanism? If this analogy be true, we should begin to realize the nature of that something which seems to persist from birth to death. Our conscious and cherished personality is mostly the momentary recognition by the operative spiritual power (as that instant within us) of the problems, characters, and conditions of the organized mechanism which it experiences, operates, and restores, and

of the mechanical relationships of that from which it comes.

In a purely physical sense, then, the charges of personality in an organization must be discontinuous, yet they will appear to be continuous. Steam forever flows from the cylinders, but it is not the same charge of steam for two consecutive strokes. The same general spiritual quality with the same type of power and purpose constantly appears, so that it has the same sort of realization of the resistances of its characteristic environment. The steam, therefore, has constantly the same general type of personality. This is true, even though the power of the principle should decrease as the days go by.

The steam, the possessor of consciousness, forever escapes from the environment of the particular into the general, from the engine to the outside universe, but in any one power-plant the steam-quality is forever of the same general type and forever has the same general impressions of its local surroundings and problems. The engine may run more feebly as age creeps over it; it may groan with many frictions as its bearings become worn; but the so-called personality will be connected with that power which preceded it, and will, for this reason, seem continuous to one who has failed to comprehend the full reality.

Nor does the steam cease to exist when it escapes through the valves. On the contrary, its powers are now associated with a different physical environment, and that part of its personality is changed accordingly. Its purpose now treats with the general instead of with the particular. But, when the engine can no longer operate, when the power within it has been weaned away, the physical part of the former dualism is like any other dead and unorganized substance. The personality as associated with that physical organism is then ended.

The part of the personality which ceases to exist, however, is only a physical aspect. Of what importance is it that this physical part of personality ceases to exist? Surely the power and purpose of the mental essence can never be destroyed by mere change in physical association; and this driving, active, subjective power which passes through

and out of the physical organism possesses its own enduring qualities, and exists forever. The broader environment now entertains it, and there it expresses itself in a nobler personality. The associations of the steam with the problems of the engine have disappeared; but the steam still exists in the wide universe, and will doubtless express itself purposefully with matter so long as the latter with its dead inertia exists.

We have not usually been inclined to measure our cherished personality as a secondary quality pertaining to the relationship of mind with a certain physique. And yet many have been led to suppose that personality disappears entirely when the body dies and decays. This is true in a sense, but if our different theory is true, the more important aspect of personality is not destroyed but is merely transformed. The steam of life does not cease to be, and will not cease to have relations with matter (will not cease to have physically-related personality) until all substance has disappeared from the universe.

The steam is conscious not only of the engine through which it passes, and which it actuates, but is aware of the past experiences of the engine, and of the results of the earlier steam-driven activities. Every occurrence which has not later been completely compensated in a physical sense may be "known." All of the past physical history—or that part, at least, which is still real and meaningful—is revealed in every pressure, in every wobbly motion, in every squeak, rattle, and jerk. The past is disclosed both in the perfections and lack of perfections of the mechanism. The steam passing through this engine is impressed not only with the inertia of the parts as they now are, but also with the remaining (and therefore uncompensated) effects of past experience. The steam of the present is thus informed of all of the mechanical past. The past, therefore, may even be used now as a guide for future conduct. The steam from moment to moment is as conscious of that which has been done as if it had lived within the organism forever.

So, also, the mental essence possessing consciousness, and basing its purposed motions partly on past history,

remains only for a short time within the body; yet, in so far as proper purpose is concerned, it can direct the organism as well as if it had been lived there during the entire life of its species.

The steam knows the past of the physique in which it momentarily lives for the reason that every physical change in inert matter will remain forever unless later obliterated by the influence of some later mentally caused act. This is true because the activities of the general power affect a particular bit of matter like the engine only partly. The general power is spread over the entire universe as its object, so that its force reaches a particular body only in the proportion that the mass of this particular body bears to the total, whereas the particular mind within any organism (if sufficiently powerful—as in the life-forms only) directs that organism only, and affects it repeatedly and individualistically, and thus makes deeper physical grooves in it. For this reason, the forces of the *general* never completely eradicate the past effects of a *particular* event. Faint though they may be, the records of past conduct endure, and by the reading of this history the consciousness that exists in the body in the moment is made aware of the significant past.

We conclude, then, that the past is associated with the present, not by means of a mentality remaining continuously within an organism from birth to death, but through the medium of an enduring physical organization—that is to say, by those physical effects which remain in the organism. The mind-power, like the steam in the engine, may remain only an instant in the body, yet during that instant it will know all that has gone before. It will know the customary routine of the mind-powers which have preceded, and it will customarily do the wholesome thing in following fairly closely this routine which has successfully survived. Human personality of this type thus seems continuous, although in one aspect it is as discontinuous as the separated water-particles which one at a time evaporate and form the steam.

Life-experiences and life-consciousness of the physical environment as then impressing the body-organism, then, are discontinuous like the separate views of the moving pictures,

but they seem continuous. The appearance of a fresh charge of mind-power is a result of the rearrangement of matter, a process which perhaps takes place instantly (for the water-particle is perhaps never half-way steam and half-way water, but is at one moment either all one or all the other); but the consciousness of the past, when intermingled with consciousness of the discontinuous present, may afford a continuous consciousness.

The relationship of mind with matter is extraordinarily interesting, and a proper conception of it is valuable also in that it affords some understanding of the nature of Space and Time. A proper conception of human consciousness may at least prevent us from concluding that in us the mechanical actions of the past are necessarily connected with the present by means of the continuation of the unit of the purely physical event. Nothing in the relationship of matter with mind, as here set forth, could make us suppose that Space and Time are consumed in the delivery of the unit of mechanical energy; or that matter must necessarily be partly physical and partly mental; or that Evolution, the process of the transformation of the single water-particle into steam—of matter into mind—requires duration for its reality. We readily perceive that sense-data (that is, mechanical impulses from the outside) may appear to be continuous even under conditions wherein the physical phenomena creating them are discontinuous and instantaneous. And yet, because some steam is always in the cylinders as long as the engine is operating, there should be a real basis for a certain type of feeling of continuous, connected-up duration—the continuous duration, that is, of existence both of the physical and of the mental characters.

If, however, the physical energy-expressions *are* themselves discontinuous—as our knowledge of the discreetness of matter makes us believe—then there must be an interval between energy-effects in which nothing happens. If consciousness can jump this interval, and yet give us the impression of unceasing consciousness, then we must renounce the argument that the apparent conscious feeling that there is continuity of mechanical event proves the reality of such

continuity. We should realize that, whether or not the unit of physical momentum consumes space or time for its energy-delivery, we have an illogical tendency to assume that events are continuous and enduring through time. Naturally, also, we are inclined to the idea of continuous physical change as a means of connecting the past and the present; and, unless the reasoning mind intervened and corrected our superficial impressions by abstractly solving the problems, we should, naturally enough, acquire quite erroneous conceptions of the facts.

We are obliged to consider at greater length these important subjects here introduced—Space and Time. This chapter, although it has consisted chiefly of two rather extended analogies, has perhaps given a logical approach to a more specific consideration of these matters. Before ending, however, I shall quote from a modern Russian Philosopher, P. D. Ouspensky, whose definite opinion is that mind is entirely separated from matter and cannot be defined in physical terms.

> "Positivism" affirms that the phenomena of life and psychic phenomena are simply the functions of physical phenomena, that without physical phenomena the phenomena of life, thought and emotion cannot exist and that they represent only certain complex combinations of the foregoing; and furthermore that all these three kinds of phenomena are one and the same thing in substance—and the *higher, i.e.,* the phenomena of life and of consciousness, are only different expressions of the *lower, i.e.,* of one and the same physico-mechanical or electro-magnetic energy.
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> But to all this it is possible to answer one thing. If it were true it would have been proven long ago. Nothing is easier than to prove the energetic hypothesis of life and the psyche. Just *create life and thought* by the mechanical method. Materialism and energetics are those "obvious" theories which *cannot be true without proofs,* because they cannot *not* have proofs if they contain even a little grain of truth.
>
> But there are no proofs of the disposition of these theories; quite the reverse: the infinitely greater potentiality of the phenomena of life and the psyche compared

with physical phenomena assures us of the exact opposite. . . .

And the world of the hidden cannot be the world of unconscious mechanical motion, of unconscious development of electro-magnetic forces. The positivistic theory admits the possibility of explaining the *higher* through the *lower,* the *invisible* through the *visible.* But it has been shown at the very beginning that this is the explanation of one unknown by another unknown. There is still less justification for explaining the *known* through the *unknown.* Yet that "lower" (matter and motion) through which the positivists strive to explain the "higher" (life and thought) *is itself unknown.* Consequently it is impossible to explain and define anything else in terms of it, while the *higher, i.e.,* the *thought,* this is our sole known: it is this alone that we do not know that we are conscious of it ourselves, that we can neither mistake or doubt. And if thought can evoke or *unbind* physical energy, and motion can *never* create or unbind thought (out of a revolving wheel no thought ever arose) so of course we shall strive to define, not the higher in terms of the lower, but the lower in terms of the higher. . . .[1]

Without making a palpable logical mistake we cannot declare life and the psyche to be dependent functionally upon physical phenomena, *i.e.,* to be a result of physical phenomena. The truth is quite the opposite of this: everything forces us to recognize physical phenomena as the result of life, and life (in a biological sense) as the result of some form of psychic life, which is perhaps unknown to us.[2]

And Mr. Ouspensky says of positivist science:

For physicists the rôle of the "creation of the world" is played by the atomic theory and the ether, with its wave-like vibrations, and further by the electrons, and the energetic, or electro-magnetic theory of the world. Or sometimes it is even worse, for the physicist in the depth of his soul feels the falsity of all old and new scientific theories but fears to hang in the air, as it were; to take refuge in mere negation. He has no system in place of that whose falsity he already feels; he is afraid to make a plunge into mere emptiness. Lacking suffi-

[1] P. D. Ouspensky: *Tertium Organum,* pp. 147–8.
[2] *Ibid.,* p. 182.

> cient courage to declare *that he believes in nothing at all,* he accoutres himself in all contradictory theories, as in an official uniform, only because with this uniform are bound up certain rights and privileges, outer as well as inner, consisting of a certain confidence in himself and in his surroundings, to forego which he has no strength and determination. The unbelieving positivist—this is the tragic figure of our times, analogous to the atheist or unbelieving priest of the times of Voltaire.
>
> . . . In all branches of scientific knowledge we are absorbing an enormous number of facts destructive of the harmony of existing systems. And these systems can maintain themselves only by reason of the attempts of scientific men who are trying to close their eyes to a long series of new facts which threatens to submerge everything in an irresistible stream. If in reality we were to collect these system-destroying facts they would be so numerous in every department of knowledge as to exceed those upon which existing systems are founded.[1]

Mr. Ouspensky says that from his standpoint "it is immaterial whether we make the foundation of matter the atom or the electron. I believe that at the foundation of matter lies *illusion,* or in other words, a form of perception." I need not say how close this is to my own belief. Yes, the essence of matter is mind-power, the power which not only perceives but acts from perceptions. Mr. Ouspensky quotes from an address of Professor N. A. Oumoff at the Mendeleevskian Convention of December, 1911, in which Professor Oumoff remarks:

> The axioms of mechanics are only fragments, and their application may be compared to the judgment concerning the contents of an entire chapter by means of a single sentence. Therefore it is not strange that the attempt of the mechanistic explanation of the properties of the electro-magnetic ether by the aid of axioms in which these properties were either denied or one-sidedly predetermined was doomed to failure. . . . The consequent development of physics is a process against matter, which ended with its expulsion. . . . (p. 128)

But, as Ouspensky so truly says:

[1] *Ibid.,* pp. 21–2.

> Positivism would be absolutely correct in its picture of the world, there would not be even one deficiency, *if there were no reason in the world, anywhere or at any time.* Then it would be necessary, *nolens volens,* to regard the universe as *an accidentally self-created mechanical toy in space.* But the fact of existence of psychic life "spoils all the statistics." It is impossible to exclude it.[1]

Ouspensky believes that both matter and spirit cannot be real—that one or the other does not possess a unique principle. He therefore denies dualism. He is right in denying more than one essence in nature, but incorrect in assuming that there may not be two arrangements of it. His error (and the similar difficulty of others), comes chiefly from the fact that it is not conceived that a single mental principle might exist in a semi-permanent structural arrangement through a considerable period of time in which it shows a distinctly different attribute from that of its essential being. The "inertia," as the character of this arrangment is called, is the prime attribute of matter, and permits the physical to have its own definition so long as matter remains. Ouspensky does not conceive, so to speak, that although ice is composed intrinsically of the steam-principle, so long as ice exists separately from steam two attributes will exist, the material ice and the spiritual steam.

We agree that a motionless piece of ice, if none of its structural parts are moving, might be unknown in any way, and may always be unknown to any mental experiences with its inner self. Only the heat-motions of steam may furnish the realizable sense-data which the ice exhibits as a combination of motion and inertia; but this does not prevent both the ice and steam characters from being real *during the time that the evolution of ice into steam is taking place.*

We agree with Ouspensky (if by "principle" he means "essence") that "as a matter of *principle* it is not important which one we regard as *first cause,* spirit or matter. It is essential to recognize their unity." In general, we agree with him also that "the world of phenomena . . . sur-

[1] *Ibid.,* p. 188.

rounds it [our psyche] as a ring, or as a wall, and it sees nothing save the wall." The steam is concerned chiefly with its engine; but, if the steam should either escape to, or commune with, the outside, then, as Ouspensky says, "if the psyche succeeds in escaping out of this limiting circle, it will invariably see much that is new in the world."

How close to this analogy of the mental steam and the material engine, which it operates as mind operates matter, is the statement of Emanuel Kant in *Dreams of a Ghost-seer:*

> Birth, life, death are the states of soul only. . . . Consequently, our body only is perishable, the essence of us is not perishable, and must have been existent during that time when our body had no existence. The life of the man is dual. It consists of two lives—one animal and one spiritual. The first life is the life of the man, and man needs a body to live this life. The second life is *the life of the spirit;* his soul lives in that life separately from the body, and must live on in it after the separation from the body.

Ouspensky remarks: "The mystery of thought creates all. As soon as we shall understand that thought is not a 'function of motion,' but that motion itself is only a function of thought . . . , we shall arrive at a premise on which the world as it is may be formulated."

In this book I am reaching some of the conclusions which more or less mystical writers have attained when journeying along different routes. Some of these have judged that the mysteries of life could only be glimpsed through a haze of instinct or emotion or trance, but it is perhaps possible that more exact, even more closely approximating conclusions, can be had through an analysis of cold facts.

William James rather foreshadows these thoughts when he says:

> Movement from feeling to thought and thence to action, from the world of dreams to the world of things, is everywhere going on. Since at each phase of this movement novelties turn up, we may fairly ask, with

> Carpenter, whether we are not here witnessing in our own personal experience what is really the essential process of creation. Is not the world really growing in these activities of ours? And where we predicate activities elsewhere, have we a right to suppose aught different in kind from this? [1]

James admitted the dualism, or pluralism, of life—even of human personality. He declares:

> *There are then ideal and inward relations amongst the objects of our thought which can in no intelligible sense whatever be interpreted as reproductions of the order of outer experience.* [2]

And again he remarked:

> So far as "thoughts" and "feelings" can be active, their activity terminates in the activity of the body, and only through first arousing its activities can they begin to change those of the rest of the world. The body is the storm-centre, the origin of coordinates, the constant place of stress in all that experience-train. Everything circles around it, and is felt from its point of view. [3]

James perceived the difficulty of defining the relationship between matter and mind, and in his pragmatic philosophy he tried to avoid this matter of solving the problem. He did not wish to surrender any of the benefits of philosophical ideas.

Here, then, at the end of a long chapter, let us summarize our conclusion somewhat. Evolution makes life, for it signifies change. Evolution, coming out of motion, signifies rearrangement. There is a dualism of arrangements temporarily in the universe, matter and mind. Matter is composed intrinsically of mind-power, but, when within substance the mental essence appears in an inert or passive form that demands an exclusive possession of certain space-

[1] *Modern Library: The Philosophy of William James,* p. 109.
[2] *Ibid.,* p. 211.
[3] *Ibid.,* pp. 156–7.

volumes. Nevertheless, this passive or material principle is willing to respond to commands to move from the active cause of motion. Free mind, the other part of the universe, is the independent, powerful, and purposeful force that is the cause of the motion of inert matter. The response of the matter-quality to mental directioning even proves that matter is composed of a mental essence in a passive state. If we agree to these principles we can never suppose, merely because some mental act seems to have a physical cause, that mind-power is disguised mechanics.

I believe in the presence of a cause[1] of motion, and I believe in motion itself because I believe in life and its change. I admit the dualism in nature and hope to prove it. As Count Keyserling says:

> In practice no one gets beyond dualism; it is impossible to think, wish, strive for, act at all without implicitly postulating duality. Why then deny it?

With this statement I fully concur. I assert a quality-dualism which represents activity in subjective mental realms, and passivity in objective mechanical realms; and I attempt to explain life-phenomena and universal phenomena by interpreting the relationships of the two. I am trying to explain that which happens as the result of the deliberate rearrangement of the passive but resistant object by the active subject. Let us proceed.

[1] A discussion of the relationship of cause and effect as postulated here is postponed for a later work.

CHAPTER VIII

THE TRUE RELATION OF SPACE AND TIME TO MECHANICS

No doubt the spirit or energy of the world is what is acting in us, as the sea is what rises in every little wave; but it passes through us, and cry out as we may, it will move on. Our privilege is to have perceived it as it moves. Our dignity is not in what we do, but in what we understand. The whole world is doing things.

GEORGE SANTAYANA

SIR ISAAC NEWTON found that the "attraction" of one body for another became greater as the space between them was diminished. Professor Einstein now asserts that the time of the movement of a body is altered by its relative motion through empty space. Energy-deliveries are altered supposedly by changes in nothing more tangible than abstract Space and Time.

A ray of sunlight pounds the earth, and the momentum of the blow, when calculated according to Newtonian principles, should vary with the relative velocity of the light to the earth. We should expect, therefore, to discover a greater velocity and momentum of sunlight in respect of the earth when the earth is moving towards the sun. The modern physicists claim, however, that its relative velocity is the same whether the earth is moving towards or away from the sun. This means only one thing—namely, that the velocity of the earth in opposition to the motion of light increases neither its velocity nor the energy of its collision. How may this be so?

Professor Einstein concludes that the time of the movement of a body in reference to a light-ray coming from a star is changed such an amount by the relative motion that the movement of the body towards or away from the star does not change the relative velocity of the light-ray. Because

of this change in Time, he suggests, the relative velocity of the light (which velocity is calculated in terms of space and time) may remain constant while the earth is approaching or moving away from the sun. According to his explanation, if a person threw a ball from the sun towards the earth at 186,000 miles a second, it would strike our world at this speed whether the earth were moving towards or away from the person. This theory of the relativity of time (or the constancy of space-time) may be quite meaningless to most people; yet the formulas based upon it seem to accord with experience. This gives it credit. This, indeed, is its principle virtue, and the reason of its being. Experience, however, may be otherwise interpreted and explained—and more reasonably.

What, then, are Time and Space, these mysterious unknowns which are supposed to possess within themselves the capacity of amplifying and decreasing mechanical energy? What does relative Motion surrender to Time that Time may be affected in its own being in a way sufficient to alter energy-delivery? Shall we accept the Relativity statement without explanation merely because it seems to give some correct answers? And shall we believe that mere variations in the amounts of intervening empty space might have the power to alter the energy-delivery of that power which we call "attraction"? Can we assert these beliefs confidently, or shall we try to explain these experiences on some other hypothesis?

Surely if we wish to reach a reasonable conclusion we must first define the relationships of Space and Time with matter (and its mechanical energy-delivery) as exactly as we can. Until we do so we shall have no real basis for an opinion about the validity of the theories of gravitation and relativity; but we shall merely be following the crowd, clinging with hopeful faith to the present hypotheses because of their seeming practicability. When, however, we have formed a more definite idea of Time and Space, we may find that the new concepts not only invalidate some of the present hypotheses but establish the basis for more reasonable theories.

As an approach to definitions of Space and Time, let us consider first the motion and then the meeting of two smallest solid bits of matter when colliding through a movement originated by a power outside of themselves. To simplify the illustration, let us imagine an isolated universe comprising only one man and two smallest bits of matter. These tiny particles are external to him, and are resting quietly in a void within reach of his hand. Until the man moves them there is no motion in this universe exterior to himself, and no mechanics for him to consider. The man, however, has the typical power to move his hands, and can, therefore, if he wishes, give motion to the particles. This universe, although it is in miniature, might well be typical; and reasoning about it should lead to conclusions valid for our larger world which contains these same two characters—mind and matter, and their attributes—and no others.

Let us now suppose that the man breaks the quietude of this exterior and motionless world by striking one of the particles and driving it towards the other. We shall consider first the motion and its meaning; then the contact and its result; and, finally, the meaning of such a result.

The body of the man will react from the blow, and when his hand is as it was before, his body will be moving in opposite direction to the moving particle. Both masses will then be moving in such a fashion that the momenta in the opposed directions will exactly offset each other in reference to the stationary centre of mass of the two bodies as it existed before the particle was struck. Physics supports this statement. This means that the centre of energy does not move—that it remains a centre of rest.

Motion of matter relative to the centre of rest of this universe is now being displayed for the first time, and this motion is a product of a mental volition. Yet this newly created energy is so exactly balanced in relation to the former centre of mass, that, in one sense, it may be regarded as non-existent. Viewed in one way the two opposed motions are self-cancelling. The motion to the right is offset by the motion to the left; the positive momentum is compensated by the negative. Nevertheless, however we may be inclined

to view these motions to the right and left in their relations to each other,—and we are always inclined to view phenomena in the way that best fits in with our preconceived theories,—the motion of this particle now moving for the first time is new and "absolute." It represents a new potentiality, and a new reality when considered in respect of its possibilities, for it is now unbalanced in respect of the second particle. The moving body may now collide with the other at rest, and move it, or otherwise affect it. This universe now exhibits added significance. For the first time it displays potential mechanical energy outside of the man, as well as possibilities of external mechanical change. The structures of bodies may now be altered, or the evolution of matter may now take place.

It is difficult to prophesy the limits of the new possibilities. If material attributes might succumb to rearrangement, even inertia might now disappear. The motion of matter exterior to the man, with all its possible consequences, is being revealed for the first time. This, indeed, we know; and, having this understanding, we cannot properly say that the new significance is self-cancelling in its parts, or as a whole. The particle which the man has moved may bring mechanical energy, and perhaps fundamental rearrangement, to any other body that it meets. We may be sure, too, that it will be moved to meet some other body—as sure as we are that the falling apple will strike the ground.

The particle is moving because "charged" with a mental will; and an equivalent amount of motion of mass must be delivered in an opposite direction before it can be brought to rest. The power of will, moreover, cannot be destroyed except by the direct operation of another will, or by matter "charged" with an opposed will. A collision with stationary particles will not cancel one iota of the motion of the moving particle, for there is no "charge" of opposed motion or will in the stationary mass. Of course some of the "charge" of motion will leave the striker and pass to each body that is struck, and the original particle, if there were others in the void, would slow down after each collision with such objects relatively at rest, but the same quantity of motion

will exist after all collisions, whether with bodies motionless in respect of the former centre of rest or with bodies moving away from it in the same direction as the striker.

Let us examine this truth in another way. If a solid ball is slid in vacuum along frictionless ice, it can deliver its entire energy—and thus be completely stopped—only by striking head-on another solid body which is moving with at least equal mass-velocity in opposition to it. If it strikes a motionless solid, it will shove this body (however large) ahead of it at a speed which will be less in the ratio that the struck mass is larger; but the forward speed, though slowing down in each contact, will never reach zero through any series of such contacts, and the moving body can never be brought to relative rest by colliding with any number of motionless bodies. After innumerable collisions with innumerable motionless bodies, the entire "charge" of motion will still exist. Not destruction of motion, but transfer of motion, occurs when the particle moving relative to the centre of rest strikes bodies at rest. The same result is to be expected when the faster body overtakes the slower. Motion can be destroyed *only by opposed motion.* This important principle has significant implications. Will-power, as exhibited by a "charge" of motion in matter, can be annulled only by a resisting will also expressed in motion.

Now some persons will doubtless deny that motion once started can ever be stopped in the sense of being eliminated from the world of mechanics; but surely anyone who is willing to agree that the man can give motion to the particle can hardly deny an equal capacity in him to stop the movement entirely, and if he does stop the moving particle with his hand all of the motion in this universe exterior to him will surely be zero again. Both acts, the moving and the stopping of movement, alter the amount of the motion of matter in this universe exterior to him; both override the doctrine of mechanical Conservation; and both, therefore, are "absolute." The universe may be finite; it may have a centre of mass which does not move; one may look from a distance at it as a whole and remark—after the particle is moved—that the centre of all mass is still the same spot;

or he may say that the movement to the left balances that to the right; but none of this permits us to deny the possibility of "absolute" variations in the quantities of motions within this miniature universe exterior to the man.

If the large universe is similar to the tiny one, if it, too, is mentally driven, then, unless one is willing to assert that the amount of motion and matter in the universe is infinite he must admit that the doctrine of mechanical Conservation fails in the face of such a situation. If, however, one speaks of infinite motion and infinite matter, then the doctrine that the amount of matter and its motion is forever one quantity is meaningless.

One might say, however, that the amount of motion might be constant. The man might keep the particles moving back and forth in approximately uniform motion. He might do this regardless of the fact that in their contacts some of this motion was temporarily cancelled. Indeed, it seems to be just this fact of constantly renewed motions that the mechanical conservationists have discovered—and then misinterpreted. They discover an approximate mechanical uniformity in their own gross and averaged experiences, and, seizing upon this, they do not understand that the motion is given to matter by a mental power; that the motion can be stopped only by the same power; that the particles moving with opposed "charges" of mental power *may* collide and thus cancel the motion in "absolute" fashion; that mechanical Conservation and uniformity both *may* be breached in every such act of will (and in every other collision or restraint that prevents the moving particles from disappearing in straight lines into indefinite space); and, finally, they fail to realize that the measure of uniformity which the averaging process does disclose in certain relationships is due solely to the principle that the mental power purposefully keeps the particles forever moving in fairly constant fashion so that the evolutionary plan of rearranging matter may be carried out. If this explanation of what an active mind-power would do is reasonable, the theory is founded on reason, and should be so regarded until disproved.

In their experience with relatively large composite bodies

in certain environments, the physicists have identified a certain type of mechanical Conservation obtaining through relatively gross time-and-space-relationships. This is motion which is continued until opposed by matter charged with opposed motion. The uniformity of opposite motions which they have witnessed and experienced, however, is a state of affairs created from moment to moment. It is not inherited changelessly from the past, nor is it what they have conceived. That which creates the motion—and the approximately uniform quantity of it—and which holds these movements within certain dependable volumes, is a power outside of mechanics. Matter could not be kept within certain volumes and in persisting structures—such a permanent relationship as our solar system, for example, displays—unless the tendencies to continued motion through a void in the direction of the start were overruled by an exterior and constantly acting principle which controls matter, and which thus overrides the basic idea of Conservation. Only if we fail to recognize outside of matter the active principle behind all the reversed or deflected motions of matter in our restrained universe, and only if we at the same time overlook these evolutionary changes within this material whole, can we suppose that mechanical Conservation has even the averaged validity and reality that is claimed for it.

Yet even while the physicists assert their usual doctrine, they know well that their belief in it is founded, not on reason, but on deductions from a certain kind of incomplete experience. And even while they assert that our solar system moves and is held together by an "attractive" force spreading endlessly through space—an infinite power thus viewed, which can attract all things everywhere—they fail to describe either the source, nature, or reality of this force. We seem to be willing to dream of this indescribable and unlimited power within matter, and yet seem quite unwilling to suppose that this force might originate outside of the matter-structure. We refuse to think that the Creator might now be active; and thus we deny the reality and potency of that spiritual Cause to Whom, in our religious moods, we bend our knees. In my theory, I have merely postulated

a universe in which the Creator's mental power and will are somewhat similar to those which we know belong to man. Is this unreasonable?

We are trying to reach an agreement here as to what will be done in this tiny universe which may well be typical, but after we have admitted step by step what must happen many will doubtless deny that which reason confirms. We still incline to cling doggedly to our mechanical Conservation even though its inconceivabilities become constantly more puzzling. We use our imagination more to explain and justify this false and mechanical hypothesis than to establish a more satisfying and more reasonable theory.

The restrained motions of matter represent an importance exceeding that of their maintained uniformity. This greater significance is discovered in the *results* of motions. A motion is justified only in its results. If motion is an attribute with which matter is "charged" by a mental power, this power cannot be regarded as wise unless the motion ends in some result affecting the mind-principle favourably. And for those of us who have abandoned the idea that there might be unlimited "attractive" forces (yet forces which do not accomplish a complete concentration) pulling matter to matter through empty spaces with powers expressed exterior to, yet generated within, and belonging to, the solid particles themselves, there remains for motions without contacts only one meaningless possibility—namely, endless dissipations. How, then, can we reconcile ourselves to the idea that a wise man would start their motion only to abandon them thereafter to the probability of infinite separation one from the other? If contacts, and the anticipated results of contacts, should cause him to move the particles, surely he would act far more sensibly if he did not surrender his control of their motions. On the contrary, the man if he is reasonable, will use his controlling power from moment to moment to create an environment (fairly stabilized as thus created) wherein the greatest number of collisions will take place with the least expenditure of mental energy. He will anticipate and even create the physical future.

This, then, is our conclusion. Have we stated the terms

fairly? If the reader were this man, and if his planned activity contemplated a rearrangement of matter-structure through collisions, would he not move the particles in front of him, and then restrain their motions, curve them, perhaps, and reverse them, and thus exercise a purposeful choice and power to create an environment in which just such repeated contacts might be expected? I believe that he would do just this; but I believe also that the formularistic mechanist, on regarding this restrained volume, would overlook the presence and invisible power of the man, and would imagine that these motions of seemingly permanent matter-bodies within fairly constant bounds, and in fairly repeating orbits, represented a self-contained, self-operating mechanism, inheriting its motions from an infinite past, moving purposelessly in the present, conforming to a doctrine of changeless mechanical conservation, and held within bounds by unexplained powers of "attraction." Yet, in subscribing thus to a meaningless mechanism founded on unexplained sources of power, these discoveries of a mere routine are denying the instinctive faith of every person in that Cause, now active, now providing, which, surely, is adding to life its meaning, its truth, and its hope.

Let us therefore carry our reasoning about this miniature universe a little farther, and consider what would happen if the man acted wisely. The motion which he gives to matter is but the beginning of accomplishment. Contact is necessary also; but even the contact will add no accomplishment unless it results in some fundamental change which, directly, or in a sequence of logical events, will lead the qualities of matter into mental realms. If a mental power is to accomplish something for itself its activity must end in a mental increasing. Some motions may accomplish nothing more than physical rearrangement of structure, and events in which, perhaps, the physical reaction equals the action. Even these, however, may be regarded as reasonable, for all motions, and the chance rearrangements of matter resulting therefrom, are justified to reason on the ground that one contact, perhaps out of countless billions, will end in a transformation of matter itself—and thus result in an effect

which does reach mental realms. Surely the formation of mind out of matter would be a fruitful field for a mind-power to cultivate. The motion given to matter, therefore, if it has plan and wisdom in it, must somehow have an effect upon mind. Yet, within those limiting bounds where the mental power does not directly intervene, the motion of a particle, as we have observed, can never be reduced (and therefore can never be used for "absolute" accomplishment) until a contact has been made, not with stationary masses, but with masses which move with opposed motion because "charged" with an opposed will. Until this opposed motion is encountered, or until a mental power intervenes directly, the moving particle simply surrenders part of its motion to the quiet particles with which it collides—or from which it is deflected—and the quantity of motion in the matter of the universe remains what it was.

Nothing really happens to the original "charge" of motion, then, until it is opposed. Only in this opposition is it possible that the motion of matter may be destroyed within the particle, and have an effect there. And, when this type of collision does occur, something which is "absolute" in respect of motion, and which is "absolute" also in respect of that arrangement known as the matter-particle, will be revealed. Something happens then within the heretofore unyielding solidity of the material inertia which is not only completely destructive of mechanical energy, but which may even be destructive of matter itself. In this collision of opposed wills within a physical organization there ensues a struggle of primary forces. In this meeting of "charges" of will, both intent on the accomplishment of the same purpose, the general motion may destroy the satisfied inertia and structure of the matter-particle. Here, where motion meets motion irresistibly in the direct collision of space-demanding particles, is exemplified the meeting of two irresistible bodies. In this meeting the physical bodies may disappear, and the passive material attributes may be rearranged to reappear as active spiritual (or mental) characters. The inertia of the most solid structure of matter, therefore, is not primal, nor irresistible!

We may say, therefore, of the universe in which motion has been created by mental power, that it holds a new possibility of significant Change. When the matter-bodies are moved against each other this possibility becomes a probability. When, however, the contacts are direct head-on collisions at high speeds in respect of the old centre of rest —and not an overtaking of the slower by the faster in movements which are both away from this centre—the probability becomes an actuality. A potential change in matter and energy takes place, and Evolution appears.

The mind-power starts motion with purpose; the mind-power reverses it with purpose; a planned collision is caused in reference to the former universal centre of mass, and in this collision there is to be discovered the consummation of plan, and the great reality. Here the mentally arranged Evolution of substance is sometimes revealed—the change which is analogous to the transformation of a material water into a spiritual steam. In this planned collision, the material arrangement is broken up and the mental power increased.

Two or three points deserve especial attention. All created motions, when viewed in terms of their potentialities, must be regarded as "absolute," but when one looks at the approximately uniform condition of the universe in any one small volume no more significance in the repeating motions is to be discovered there, no more "absoluteness" is to be seen in them, than in the waves of the sea or in the oscillation of the pendulum. We grant that this centre about which matter is moved is not itself changed by this created motion, but what does this signify? Nothing whatsoever with regard to those problems of the particulars in which we are interested. We are concerned with the problem of rearrangements of the material structure, and we may cherish the idea of a changeless centre of motion, if we wish, and we may say, because the motion is balanced and equal in opposite directions, that none of it is "absolute" or even real. In doing this, however, we shall fall into serious error, for we live within the universe, and our lives and experiences are created, not by the movements of the whole, but by *the changes within the whole.* For this reason the very

beginning of motions, the creations of waves, the impulses which give added movement to the pendulum, should all be significantly expressive to our reasoning minds. These phenomena should represent to us mind-actions which are accomplishing life for us in this moment. What, then, can be more important for us than this evolutionary Change—the creation of these motions which we so interpret?

We have postulated for our universe a wisdom which will limit movements and bring about general limits to, or cohesion in, the space-relations of material particles. There is nothing new in the thought that the universe is limited. Many scientists have so contended. Our solar system is certainly restrained so far as we observe. We have usually believed, indeed, that its own attractive forces held it together, and that no important relationships with other parts of the universe were needed to explain its persistent structure and volume. Professor Nicholas P. Ravetsky writes that if the universe were infinite, the light of the stars would be infinitely bright, and their heat infinitely great, and gravitation would be all-powerful. He says, however, that "we cannot determine, from any facts now available to man, whether the space we live in is "curved" or not; whether our actual universe is finite or infinite.[1]

This argument about the necessarily infinite amount of light and heat and gravitation if the universe were really infinite is not easy to answer, but it should not be put aside. If the earth had two moons, would her lunar attraction be double that which the one moon feels? If all space were packed solid with moons which touched and filed away in series into indefinite space, how much total "attraction" would the earth be capable of exerting? How much does she now exert on all the matter that there is? If the matter is really infinite, is the attraction infinite also that the earth seems so easily to express outside of herself? If it is infinite in potentiality, why is it so limited in its action towards the moon? Yet, if limited, how can it act with corresponding force on another moon that might be placed just behind the present moon—just as if the real moon were not there? Is

[1] *Scientific America*, September, 1925.

the attractive power of every grain of sand as infinite as that which we attribute to our earth-body? Are all things infinite or are they finite?

Indeed, must not the force which restrains the orbit of the earth be one which has no mechanical potentialities when referred to some direction in space wherein no matter exists? And isn't the universe of matter limited also? The quantity of matter is certainly limited in all those finite volumes of our experience. Matter does not fill a billionth part of the volume of our solar system. Wherever we observe matter it shows no relationship to infinity, but appears in modest percentages. Professor Einstein, too, has reached the conclusion that the material cosmos is finite, and has even calculated its approximate total mass.

Whatever the scientists may assert, the idea of a limitless universe does not recommend itself. A sensible philosophy of the motions of matter cannot be founded on the concept of an unending extension into which the material bodies might move farther and farther apart, ceaselessly. An event has no law, no principle, no meaning in relation to an infinity of events. There is no ratio between the finite and the infinite. As sane were it to ascribe significance to the efforts of a boy who was attempting to drain an infinity of oceans with a tea-spoon as to the changes of the position of a corpuscle of matter in an infinite space. The universe must be finite, limited, or else there would be no dependable material forms and structures in it. Nor would there be sensible purpose in its motions. For infinity to be conceivable motions should be absent, and an infinite matter should pack all space solidly. The form of such solidity would then be dependable, but it would be meaningless, unreal, and unworthy of mental investigation. If, however, the universe is finite, we may talk of its principles, and we may ask what force holds it forever restrained like the solar system, in a structure, and with a volume that can be depended upon, and with systematic motions within this volume which have routines that may be formulated. And if the universe is changing, life in it may be interesting.

For myself, I have reached the conclusion that no at-

traction of gravity forever curves the planets in their repeating orbits about the sun. I have already advanced arguments to show that no such force could exist within a matter-body, and yet be expressed outside of the body indefinitely into and by means of nothingness. Later, I shall adduce facts known to physics to support my view that the oval planetary orbits cannot result from the radial "attractions" of the sun upon worlds moving with inherited straight-line velocities.

We have imagined a miniature but typical universe consisting of a man and two particles. Let us consider it further. The particles might "attract" each other appreciably, if attractions were real; but here we find the particles at rest, with no tendency to move until the man gives them motion. Not internal forces residing within the particles, and stretching out from within them in every direction, cause them to approach each other, but rather a more real force—the recognizable power of and within the man. The concentration of matter is here arranged by this man, and it is therefore mentally ordained. And when he acts, motions appear in space-volumes where previously they did not exist.

After the man has struck one particle we may say that its contact with the other is inevitable, for the collision and its results represent the carrying out of a mental purpose behind the act. Here, in this collision, moreover, the attributes of the material particle become particularly significant to the mental power. Inertia, also, is meaningful to the man because mental energy is consumed in giving motion to an inert mass. And when the matter-particles collide, inertia is again potent in a mechanical sense. The changes caused by these collisions, and the rearrangements of structural parts, and their corresponding transfers of motions from part to part, are mechanically important also. If, moreover, any of the collisions should end in the formation of a spiritual (or mental) essence out of matter itself, how important this act will be! The mental significance of this universe comes, therefore, from the motion of matter—this imponderable motion which is not inertia but a "charge" of mental will.

Suppose it is here argued of the miniature universe that the motion given matter by the will of the man may deduct

something from the remaining powers of his will? If this were true, it means that in the broadest view there is a real Conservation—a Conservation of the mind-power of the universe. Such a doctrine may well be true of the tiny world of the illustration, also of the larger one about us,—but this type of Conservation is not that purely mechanical principle which the physicists rely upon, for they have made the grave error of postulating a Conservation that pertains solely to matter and its motions. Like Herbert Spencer, they have misinterpreted a result; and they have failed also to ascribe reality both to the cause and to its influence. Lastly, they have failed properly to interpret the purpose and accomplishment of the Cause. They have believed that both matter and its motion are indestructible, primary, and forever real. They have failed to conceive that mechanical energy comes from mental realms, and spreads out because of a mental act. Hence they fail to realize that at any moment it may disappear into a mental focus. Many physicists even believe that matter is the essential principle of the universe, and that mind-power is related to the physical. They are partly saved from their inability to explain the mechanical universe in these terms by their concept of "attractions"; but this postulate, also unreal, leads them into other difficulties mental and mechanical from which there is no escape.

Conservation is defined by Newcomb in purely mechanical terms, and his physical view has been accepted almost universally by the physicists. His definition reads:—

> No form of energy can ever be produced except by the expenditure of some other form, nor annihilated except by being reproduced in another form. Consequently the sum-total of energy in the universe, like the sum-total of matter, must always remain the same.

Bold man was Newcomb to say so positively that he had discovered the primary unchangeable; and how mistaken he was! His mechanical Conservation is acceptable to no one who admits the presence and power of Will in the universe as a separate character from matter. One must be sure that

the man cannot move the particle in front of him, and thus by his volition, by his own now typical and real mental principle, create the reality, and the location, and the time of this mechanical energy, which, except for this expression of a volition (and therefore, of a non-material principle) would not thus exist. Either this, or he must abandon his positive belief in mechanical Conservation. And he must be able to explain also the repeating planetary orbits by some other principle than "attractions at a distance." The power that gives matter all of its movements, like the man-power of our analogy, lies quite outside of the particles themselves. It results neither as a mechanical attraction nor as a repulsion. And when we accept the power of mental volition and will as our cause, we can perhaps explain the phenomena of the universe in terms of it.

Many physicists seem to perceive only the less important part of what is happening. Because it is difficult to discover the dissolution of an invisible corpuscle in a mechanical blow, they deny the disappearance altogether; and because motion seems to be present to their experience in constant amount, they suppose that it is neither created, destroyed, nor reversed with "absolute" power, nor renewed from moment to moment, nor spread into new volumes. They (except those who accept the Einstein hypotheses) believe, indeed, that motion is somehow an attribute of matter in the sense that it may be developed from matter as an attraction or a repulsion at a distance; and that it is so developed in matter as an "attraction" sufficiently in excess of repulsive effects as to hold the solar system only fairly concentrated, and so as to remain in dependable moving relations of parts. And Einstein assumes that the presence of mass at a distance has the ability to curve space-time. They think also that motion may no more be destroyed (except as it is destroyed and reversed in the orbits by "attractions") than matter can be destroyed. They strain their sense of fitness in trying to interpret universal happenings. Yet, many of these theories are hopelessly puzzling.

Many think that physics supplies science with a closed system in which physical relations are infallibly to be inter-

preted on a basis of mechanism; that mechanical events in this system are connected one with the other as in a perfectly compensated circle; and that this system is blocked off to itself, and quite disconnected from consciousness. Thus Professor Arthur S. Eddington of the University of Cambridge says: "Theoretical physics turns a blind eye on the track which leads to consciousness." This track to consciousness is nevertheless somewhat real to him, for he plots the connection with mind as an avenue leading away from the perfect physical circle. It is not altogether real, however. At least its effect and presence are not defined.

After taking a similar stand, many physicists appear to be satisfied with the uninteresting repetitions of the penetrated but still supposedly closed and perfect circle. Professor Eddington says that "the avenue is blocked in the direction leading *to* consciousness, for any properties of the entities by which they could interact with consciousness have been dropped from the symbols. The edifice of theoretical physics which has been built up from these symbols can therefore contain nothing capable of interacting with consciousness."[1] This virtually means that science has been so arranged that it does not include anything but mechanical determinism.

This arbitrary blocking of the road leading to consciousness solves the problem, the physicist is apt to think. The question as to whether one has a right to block off this influence is usually avoided. It is assumed, too, that the unaffected physical circle has a complete, self-supporting, and basic reality of its own. The mechanical chain is offered us as a "spontaneously" appearing cycle of motion that, for some unknown reason, happens to be a circle of this particular diameter—and one that can be of no other dimension. We are informed merely that what *is,* is mechanically "necessary." The physicist usually thinks nothing more need be said. The question whether this chain of physical sequence has not a completely mental origin, whether the very diameter of the physical circle (a curve which exists in the presence of and by means of motions and deflecting con-

[1] Various Writers: *Science, Religion and Reality,* MacMillan's, Essay: *The Domain of Physical Science,* p. 207.

tacts) is not mentally planned, ordained, and executed, is not seriously considered. To the usual physicist this problem seems to be of no practical importance. Here is the mechanically perfect circle—as it is. Let us accept it, and make use of the generalized laws of its average condition and motion, and be satisfied with the practical returns. Who cares about anything more?

Yet, Professor Eddington admits that consciousness is not without its influence on events. It appears to influence physics on one side of his diagram. At least his chart shows a route leading from consciousness to matter, and something must pass if the route is to be regarded as real. We wonder, however, if the mental influence is *really* real, the way he regards it. We wonder if it *does* have an effect on the physical circle. When speaking of the world of physics external to consciousness, he says that "it derives actuality and value from consciousness." (p. 214) This seems rather conclusive, but on the next page, he remarks that, within this physical cycle, as thus influenced sidewise by consciousness (so to speak) "violation of these laws [laws of the physical sequence] are inconceivable."

Perhaps these short passages do not convey the real meaning of this famous astronomer,[1] for in the same essay he says that he fears "that there can be no satisfactory theory of free-will without admitting an inference with statistical laws." Again he writes:

> Our thesis has been that the recent tendencies of scientific thought lead to the belief that mind is a greater instrument than was formerly recognized in prescribing the nature and laws of the external world as studied in physical science; that in exploring his own territory the physicist comes up against the influence of that wider reality which he cannot altogether shut out; and that by its selection of values the mind may indeed be said to have created its physical environment. (p. 217.)

These quotations indicate that doubts and mysteries puz-

[1] Since writing these sentences Mr. Eddington's work *The Nature of The Physical World* has been published. In this book he strives earnestly to make a place for mental power and volition as independent realities.

zle the physicists who believe in closed cycles of physical relationships in which mechanical Conservation reigns supreme. However this may be, you, my reader, if you stamp your foot when you read this page, will not deny that mind-power has caused a motion which except for mind-power would not then have been exhibited where and as it then *is* displayed. And if two particles and you should compose a universe, you will admit that you could cause the particles to move or stop, at your pleasure. You could thus give to these inert particles an "absolute" energy of motion. Granting that this is reasonable, the greater question becomes: What *would you do* in such a universe? And would your reasonable activity provide us with a universe such as ours is—namely, with almost a constant quantity of motion, and yet with a real Evolution in it?

In his essay, *The Queen of the Air,* Ruskin writes eloquently on this subject:—

> We will assume that science has done its utmost; and that every chemical or animal force is demonstrably resolvable into heat or motion, reciprocally changing into each other. . . . Granting that we have got thus far, we have yet to ask, What is heat? or what motion? What is this *"primo mobile,"* this transitional power, in which all things live, and move and have their being? It is by definition something different from matter, and we may call it as we choose—"first cause," or "first light," or "first heat;" but we can show no scientific proof of its not being personal, and coinciding with the ordinary conception of a supporting spirit in all things.
>
> Still, it is not advisable to apply the word "spirit" or "breathing" to it, while it is only enforcing chemical affinities; but, when the chemical affinities are brought under the influence of the air, and of the sun's heat, the formative force enters an entirely different phase. It does not now merely crystallize indefinite masses, but it gives to limited portions of matter the power of gathering, selectively, other elements proper to them, and binding these elements into their own peculiar and adopted form.
>
> This force, now properly called life, or breathing, or spirit, is continually creating its own shells of definite shape out of the wreck round it: and this is what I meant

> by saying, in the *Ethics of the Dust*:—"you may always stand by form against force." For the mere force of junction is not spirit; but the power that catches out of chaos charcoal, water, lime, or what not and fastens them down into a given form, is properly called "spirit."

I emphasize the thoughts of Ruskin when I say that you, considered as the omnipotent creative Cause, who have created motion in the universe by your will, according to your reason, and therefore with a purpose, can restrain within bounds the movements that you have caused, can catch the matter that you have started moving before it passes into endless space, and can return it again towards the centre of mass. You can cause it finally to accomplish that for which you moved it.

You, Master of all life, movement, contact, and accomplishment, if you propose to develop change from the collisions of the particles that you have caused ceaselessly to move; if it is your plan to disrupt and rearrange the inorganic realm —and thus draw the organic from its materialistic nest—if you have *willed* to obtain these renewed contacts and their results, and if, so to do, you must restrain and reverse motions within circumscribed bounds, you would perhaps arrange yourself around this universe in enveloping fashion, and return the matter of it forever into one volume, and to the inevitable contacts therein. Like enclosing banks, you might restrict the motion of the material fluid so that while it seethes in whirlpools, and evaporates and disappears in concentrating vortices, it will nevertheless be restrained by your circumscribing and relentless pressures so that the separate drops will come forever again and again into regular contactual relationships. Truly, if this were your plan and accomplishment, you should be regarded as the Creator of all those seething formations and snug cohesions in which the involution of the material fluid and the creation of the etheral steam are constantly being manifested.

The description of the significance of the motion of the universe is now ended. One of the particles has now been moved by the man. It is charged with his will-to-move, and nothing can stop it and restore quietude except another ex-

ercise of will—either a direct application of the man's will, or the collision with another body moving in response to another and opposed "charge" of will. Let us now discuss the phenomenon occurring when this "charged" moving unit particle of matter collides with the stationary one, for this is the principle consideration of our chapter.

As our definition of matter means that the two units cannot, or will not, occupy the same space-volume, something must happen when one particle reaches the extension occupied by the other. Speaking in mechanical language, the first particle is said to give a blow, or impact, to the second. This blow, which really signifies a transfer of part of the "charge" of motion from one particle to another, is full of meaning. If the particle is of unit mass, and if it moves at unit speed, its blow is the true unit of energy-delivery.

We have already noted that the motion of a solid body cannot be reversed except by the receipt of a blow from a body moving in an opposed direction. It follows, therefore, that if both particles are solid and rigid throughout,—as the smallest bit of matter by our definition is,—and if neither particle manifests within its space-volume any motions of parts in reference to its own centre of mass, then, when the collision occurs, part of the "charge" of motion must pass from the striking particle to the struck. In reference to solid units, elasticity is impossible. If only one unit is moving into the contact, moreover, rebound is impossible, because rebound in such case would signify a reversal of motion without an opposed movement of matter as its cause. Rebound between colliding bodies, when only one is moving, is a phenomenon which can occur only when there is "elasticity"; and this power to reverse moving matter is only possible when the material object is composed of parts some of which are moving in opposition to the motion of the striker. From this simple principle we can deduce much. First elastic rebound can occur only when collisions take place between *composite body-organizations having parts moving in various directions.* Furthermore, elasticity is a function of time. Cohesive resistance accumulates in proportion to time. When unit energy or unit time is discussed, elasticity and rebound

may be entirely forgotten. Indeed, as Professor G. D. Birkhoff of Harvard has recently pointed out, "If two elastic bodies collide at sufficiently high velocities the laws of elasticity and 'cohesion' fail completely and resulting motion is indeterminate." In those cases of great velocity the "cohesion" (the elasticity, that is) does not have time to accumulate from the external sources which make structural elasticity possible. This experiment conforms perfectly with our theory of the true meaning of "elasticity."

When one particle is moving from north to south and strikes another stationary unit particle, then, according to physics, if the two particles are of the same mass the southerly motion after the collision will continue at half the velocity of the moving particle before the contact. If the striking unit is moving at ten feet a second, after the collision the double mass will be moving at five feet a second. As the struck mass increases in quantity of matter, more particles will share the "charge" of motion of the striker. If a single particle encounters head-on nine others which are stationary, there can be but one result—each of the nine particles will accept its share of the "charge" of the motion of the one that was moving, and, immediately thereafter, the ten, each one-tenth "charged," will move at one-tenth the former speed of the one. Whether this collision ends with a decrease of the total motion within the universe depends upon the relationship of the motions to the universal centre of rest; but as a collision *per se* we need not consider here the question of the possible destruction, either of "absolute" motion, or of matter. As we shall later observe, the conventional concept is quite erroneous that in such collisions part of the kinetic energy of motion is always accounted for in some other form of energy.

We have discussed briefly what happens to the motions when unit solids collide. Let us now consider the collision in reference to the Space and Time involved in the event. Here we are reaching the heart of our subject. We shall first quote from Herbert Spencer:—

> It is an established mechanical truth that if a body, moving at a given velocity, strikes an equal body at rest in such wise that the two move on together, their joint

> velocity will be but half that of the striking body. Now it is a law of which the negation is inconceivable, that in passing from any one degree of magnitude to any other, all intermediate degrees must be passed through. Or, in the case before us, a body moving at velocity 4 cannot, by collision, be reduced to velocity 2, without passing through all velocities between 4 and 2. But were Matter truly solid—were its units absolutely incompressible and in absolute contact—this "law of continuity," as it is called, would be broken in every case of collision. For when, of two such units, one moving at velocity 4 strikes another at rest, the striking unit must have its velocity 4 instantaneously reduced to velocity 2; must pass from velocity 4 to velocity 2 without any lapse of time, and without passing through intermediate velocities; must be moving with velocities 4 and 2 at the same instant, which is impossible.[1]

Reason has defined for us the unit of matter. We shall not repeat this definition more than to say that this unit is solid, cannot be compressed, and cannot be rearranged internally without becoming more different from matter than steam is different from water. Spencer has described a collision between two solids, and has said that they "move on together" after contact. The modern theory of physics definitely affirms that when a horizontally moving solid collides in vacuo with another of equal mass at rest on a frictionless surface, the two bodies will move off in contact at half the former speed of the mover. We shall consider this in more detail later, but here we may note that nothing else could happen unless the two particles were able to produce a new and unique unit of matter by occupying entirely or in part a single unit space-volume. But if they did this, the particle would then be neither solid nor incompressible. If the unit particle is forever one thing, it must cling to its own definite amount of space-volume, and its definition must not be variable.

If one solid particle strikes another at rest, symmetrically and head-on, continued motion may be expressed only in that same direction, for there is no force that might cause deflection, and no possibility of rebound. As neither par-

[1] Herbert Spencer: *First Principles*, pp. 49–50.

ticle has open spaces, there can be neither compression nor yield. It follows, furthermore—because the motion of the striker cannot be destroyed, and then recovered later out of nothingness, and because at the beginning of a contact one body is moving while the other is relatively at rest—that the striker must remain in constant contact with the struck. The striker cannot slow down, and wait while the struck body acquires motion, and then accelerate into a new contact, but it must continuously push the struck body into its increases of velocity.

Two solid bodies, however, cannot stay in contact while moving at different speeds. This makes it necessary that when they collide both change speed instantly. The moving particle must impart its energy-change *immediately.* The moving particle cannot react from the stationary one, and then later pick up its lost speed and regain the contact. Velocity lost in a retardation can never be regained unless some other activity in the environment restores it. The perfectly solid particle cannot overlap the struck particle like a rubber ball might do, and thus, by elastic yield and later recoil, consume time for delivering its blow, for the unit-particle possesses no elasticity. It has no subdivisions that may first come closer together and later spring apart, and, according to our assumption, it is alone in an empty space and uninfluenced by its environment. This assumption of a condition of mechanical isolation is true, however, of all unit bodies during their periods of movements from one point of collision to another. The doctrine of Conservation may be maintained, therefore, only by the constant contact of the two particles, and only by the constant delivery of motion by one to the other. The solid striker must be in continuous contact with the solid struck body during the entire period that one slows down and the other accelerates. This indicates to reason that when a moving and incompressible particle does strike another one which is motionless, in the transfer of motion there is no time-consideration. This is the vital thought.

The way out of the conceptual difficulties of Spencer and others is so simple and obvious that it is strange that these thinkers have not discovered it. Because of misleading pre-

conceptions they have failed to realize that the "charge" of motion passes from unit to unit of matter *without consumption of time.*

We have probably never experienced perceptibly distinguishable sensation from isolated unit-particles; our empirical knowledge has referred principally to the sense-data afforded by the contacts of composite formations; our beliefs have been formed in relation to generalized experiences; and we have made the grave philosophical error of supposing that principles which referred with fair accuracy to the averaging measures of gross composite masses immersed in a pool of matter-particles delivering blows almost unceasingly and from all sides (so far as we can tell from our gross sensations), were true also of the isolated unit event. And yet, if the Conservation is true even in respect of the passage of motion from a moving solid to one at rest, and if the unit colliding bodies *are* solid, inelastic, and isolated, we perceive that the unit of motion (and energy) must be transferred instantaneously on collision. Nothing else is possible.

Time enters into the happening therefore only in the proportion that there are open places in the structural formation of the colliding structures. In observing the collisions of bodies of varying solidities we can discover a proportion between the time of energy-transfer and solidity. From this we might have deduced the principle that, when true solids collide, the "charge" of motion must pass instantly. When two solid and, for the time in question, isolated bits of matter collide, the period of energy-delivery must be zero.

Spencer could not conceive that motion might be transferred instantly on contact, yet he realized that any other belief was inconsistent with Conservation. His statement that it is impossible that an object should be so retarded that its velocity will be 4 and 2 at the same instant becomes meaningless when we take the stand that we are dealing with an occurrence which requires no time for its happening. If a transfer of motion is instantaneous it is not "impossible" but inevitable that the particle should be moving with velocities 4 and 2 at the same instant. What is the

meaning of "the same instant" when referred to an event in which no time is involved? Such an "instant" would be zero, to be sure, and if a body changes its velocity in zero time it can be regarded as moving at any number of conceivable velocities at once. The actual condition depends solely upon the facts of the case. If it be true, then, that an act requires no time for its performance, considerations of time-intervals in relation with it are absurd.

Herbert Spencer was entangled in a paradox involving apparent impossibilities merely because he did not believe in the one possibility which would relate his ideas and explain his difficulties. He was accustomed to associate time with changes of velocities in composite bodies, and he could not conceive that the unit-changes of velocity involved no duration.

With a different hypothesis both the impossibility and the paradox disappear. The Conservation axiom of the physicist is preserved as far as it should be, and clearer understanding is had of phenomena that would always be mysterious if it were supposed that Time were a factor, either in the passage of motion from one bit of matter to another, or in the actual increase of velocity which the repeated instantaneous deliveries of unit-energies promote. Nor does this concept of immediate motion-transfers, unit by unit, call for any drastic change in the Newtonian laws of motion as used in common practices, for in them the time-and-space-relationship need not be defined in terms of exact units, but can be grossly averaged to include many units.

Where is the lack of reasonableness in the idea that motion might be given to matter by will *instantly,* and that this "charge" of will should pass from particle to particle without consumption of time? If a particle "charged" with electricity were brought into contact with an object, would one contend that the "charge" of electricity would pass with a speed relative to the approach of the two bodies—perhaps ten feet a second—rather than at a velocity characteristic of electricity itself, or about 186,000 miles a second? Why, then, if motion represents a "charge" of mental will, should we demur at the thought that when two particles collide the

"charge" passes from one to the other at the characteristic velocity of the will's activity? Why should mentally-given motion pass in some ratio to the relative velocity of the moving structures? The mental "charge" adds no appreciable weight to an object; it has no appreciable inertia nor mass; hence it may well enter and leave a body at its own characteristic velocity. There seems to be nothing unreasonable, then, in the belief that the "charge" of the "will-to-move" passes from one bit of matter to another at the speed characteristic of thought itself. This concept appears to be logical. It is even necessary unless one is prepared to deny the distinction between motion and mass.

What, however, is the velocity of an act of organic will? This is the next question; for whatever this typical velocity may be we should expect a "charge" of it to pass from unit particle to particle at this speed. We are already disposed to abandon the old theory that the velocity of the delivery of motion is in some proportion to the relative velocity of the moving composite structure. And when we consider the velocity of thought, we realize that it can fly to a distant part of the universe instantly, although light-rays (moving at a speed of 186,000 miles a second) may take three hundred thousand years to come to us from a nearer point. If our wills could move the farthest star without the use of a material connection like that of our bodies, or if the space between us and the star were packed tight with incompressibly solid matter, the star would respond *instantly* to our commands. Our arms, however, do not move immediately in response to our wills. To reach our arms the "charge" of will must pass through physical nerves and muscles. This translation of energy, even in our bodies, is a mechanical translation. Time is consumed here, as everywhere, not in the energy-transfer itself, but in the motion of matter through empty spaces up to the point where the contact with the other object is made. The smallest parts of every structure are separated from one another, and each bit must move through empty space to come into contact with another bit. *Matter, in moving, may consume time, therefore, in passing through the empty spaces between separated bits, but no time is taken*

in the transfer of energy after one smallest particle has come into contact with another.

This last sentence holds the essential thought. We must admit that the velocity of the transfer of the "charge" of will has no relation to the velocity of translation of the "charged" mass as a whole through empty space. If time is consumed in the transfer of motion it is unappreciable and incalculable.

The acceleration of the body of our usual experience is due to a succession of almost innumerable contacts each one of which adds its part to the energy of the movement. There are myriads of oscillating particles in every object of appreciable size, and they are so uniformly spaced, and the amount of energy transferred in any small time-interval is so constant that the total energy-transfer in gross can be calculated as if it took place in a certain ratio to the elapsed time. The delivery of the energy of a balanced mass composed of billions of unit-particles depends, therefore, upon a time-factor, but not because time is consumed in the transfer of the unit of motion after the contact of the unit-particles has once been attained. There are countless quintillions of corpuscles in the head of a pin, and yet the empty spaces between them are millions of times greater than the spaces occupied by them. These gaps of emptiness must be traversed before the separate pieces can deliver their full momenta to the struck object. Time passes, therefore, while an increasing velocity is being built up, but this fact gives us no right to assume that time is consumed in the energy-transfers themselves.[1]

If the unit-particles were packed so tightly in a body that they filled all its internal spaces in a solid and incompressible mass, a blow from this body would be far more abrupt than the impact of a cannon-ball against armour-plate, but, as things are, every appreciable delivery of energy (energy-delivery in gross, that is) results from a succession

[1] Professor Millikan gives us an idea of the enormous number of electrons (perhaps themselves composites of still smaller particles) that we must deal with in everyday life. The number of electrons which pass every second through a common 16-candle power electric-lamp filament is so large that it would take the two and a half million people in Chicago counting at the rate of 2 each second, twenty thousand years of 24-hour working days to count an equivalent number.

of incredibly minute shoves. There are time-intervals between these shoves, to be sure, but each shove is itself imperceptible and immeasurable, and represents an *instantaneous* transfer of a small amount of the "charge" of motion. However, since the unit of acceleration is instantly received, *no time is involved in the acquisition of any speed—however great it becomes and whatever the environment.* During the interval between the instantaneous unit-blows, velocity does not increase. We shall carry these important ideas somewhat farther in the next chapter.

Empty space, then, is a place in which matter moves without interference—that is, with no evolutionary change. It has no mechanical significance during the period in question. As there is nothing physical in empty space to retard or increase motion,[1] free movement in it is necessarily uniform and uneventful. There is a measure of empty space between every two particles of matter except at the instant of collision. Acceleration, on the contrary, caused as it must be by the energies received from the blows of the smallest bits of matter, is a terrace-like formation of steps upward to higher speeds. The riser of each step is to be regarded as instantly traversed. It connotes real change, and is, therefore, eventful; whereas the time consumed in the passage over each tread is used in conquering an empty void. After the passage of a certain average amount of void a new contact occurs, and then a new riser of change shoots immediately upward. The tread lies in a flat uninteresting plane. Time is required merely to pass through this extention of nothingness. Duration is thus directly related to the elapsed time of composite energy-deliveries, and to this alone. No other conclusion is consistent with the definition of matter.

Only the intervals between the multiple blows of composite bodies may be calculated as functions of time, therefore, and none of this duration refers to the transfer of motion itself. Let us not build upon an incorrect theory, then; let us not accept as completely valid an erroneous

[1] We do not assume that there are any forces of attraction or repulsion in the empty spaces between matter-bodies.

mechanical formula merely because it has practical value as an averager of results in certain gross types of experience. Truer conceptions of Time and Space, even those supported by reason, may reverse our present conceptions of gravitation and magnetism, may cause us to abandon the Einstein hypothesis, and may afford us a better comprehension of the happenings in the universe.

Time advises us relatively how long matter moves without receiving or bestowing impulses, but time is not an ingredient in mechanical change as it occurs—except in so far as this change refers to average result taken of a composite structure. Empty space advises us of the distance that matter moves without energy-influence, and serves no other purpose. Physical space, or extension, establishes the size of the unit-particle. When referring to activity, to "absolute" change which is more than the change of relative position in respect of a void, or to the transfer of energy from one solid of unit matter to another, or from will to matter, we must regard Time and Space as non-participating. Neither of these principles pertains to the energetic happening itself. Neither is a factor in the mechanical event.

No physicist has been able to explain the significance of the time-interval in the delivery of the unit of energy of motion, or in aggregations of this unit-delivery. All have encountered the difficulties that Herbert Spencer described, and it is strange that they have so long clung to the belief that time *is* consumed in the transfer of unit-motion.

We have seen also that Space is not involved in the transfer of motion. Let us make this point clearer. Let us imagine two rigid, inelastic, and uniform spheres, each ten feet in diameter, one at rest and the other moving through a void so as to strike directly against the first. If the spheres are indeed perfectly solid and inelastic physicists will agree that after the collision they will move along touching each other and at half the speed of the striker. I have here used Spencer's illustration, but I have purposely assumed a larger dimension than that of the smallest particle in order to illustrate the principle more clearly. Before the contact, the entire potential energy of the sphere taken in reference to

the ground is situated as if at its centre. After collision, the centre of the remaining energy is half-way between the two spheres, or at the point where they touch. They now move along in contact, and at half the speed of the striker.

Is this not an extraordinary change in the position of the effective energy? Before contact the motionless sphere had no potential energy, and the moving one contained all of it. Now, instantaneously, on contact, the location of the potential energy has jumped the length of the radius of the sphere. Five feet of space has been cancelled instantly as it relates to the focal point of the centre of energy. In all truly incompressible bodies, therefore, the position of the effective energy, when collisions occur, moves timelessly. Evidently, then, no space-time considerations are involved either in the movements of energy from one unit of material extension to another, or in any series of contacting units. Mechanical energy as transferred by contact (and we shall claim that there is no other sort of mechanical energy), as we seem obliged to admit, is not associated with Space or Time in its passage from one unit of matter to another. *Space and Time appear, therefore, as mere conveniences for recording the conditions when no energy-transfer is taking place.* With them we also make comparative reckonings of intervals between different series of events.

Another form of space refers definitely to matter in that it defines the extension of the unit-particles. This physical extension of space is useful for measuring the dimensions of the unit-particle and also (in multiples) for measuring the limits of structures composed of many particles, but empty space (which is not extension) *has nothing to do with the activities of energies of matter.* Nor can energy-delivery be measured in terms of the physical extension of space. Should matter all be transformed into non-matter all ideas of extension and of space-time relationships must vanish at the time substance vanishes. During the transfers of energy from mass to mass, space-and-time-relationships are absent. They refer with relative accuracy only to the no-energy periods—that is to say, to the intervals meaningless in an evolutionary, or truly mechanical, sense. They relate with some precision

and dependability to these intervals of non-occurrences, and also to the durations intervening between significant events.

Space, therefore, is merely an abstract conception conferring dignity either upon that which is not—that is, upon mere emptiness—or upon the physical extension of the unit of matter. And as to such physical extension, the space occupied is never realized sensationally nor mechanically. As to Time, so far as it refers to the physical universe, it relates only to the duration of the movements of objects through voids.

Without ideas of Time and Space we should have difficulty in summarizing (or averaging) the phenomena that involve the wide spread of relationships of those composite bodies with which we usually treat, and within which we can neither perceive nor measure the unit event. To have conceptions of the relations of instantaneous events taking place repeatedly (in empty time and space) in groupings composed of many particles too tiny for our direct perceptions, we must needs imagine abstract negative qualities to act as fillers between the separately immeasurable happenings and to extend them into a series that is subject to our perceptions. We require these abstract fillers to account for, *and to average up,* these tiny durations wherein there are no contacts and no life-changes. These fillers, we now observe, are supplied by our ideas of Space and Time. When events no longer occur, when substance no longer exists to move and strike other substance, when changes in matter no longer take place (or when unit events are under consideration), there will be no time nor space to be considered. Space, Time, and the physical life created by the transforming blows of matter, will have become completely unreal and impossible in that age when there is no matter which a mental power may move. Convenient symbols as they now are for our lives, we have inclined to attribute to them a reality which they do not possess, and even the ability (by their own "spontaneous" self-variations) to cause changes in energy-expressions. Yet these concepts now appear to be unreal.

We may help to verify this theory of Time and Space by

considering our mental relationships with these mechanical events that give us sensations. We can perhaps confirm our belief that no time is consumed in the transfer of mechanical energy by considering our personal experiences with the blows of matter. We may also help to substantiate our hypothesis by considering further the blows of a theoretical group of particles in a parent mass, and by showing that it is incredible that the delivery of the energy of any of this group of particles should be made at the speed of the parent group as a whole. Although a rather conclusive argument has already been presented, yet the matter is of such importance that I shall risk tiring my readers by presenting a detailed proof drawn from both mental and physical experiences. Then, as a final study of Space and Time, I shall consider the mechanical formulas from which we have drawn the incorrect assumption that time is a factor in the transfer of energy.

CHAPTER IX

CONFIRMING THE CONCEPTS FORMED ABOUT SPACE AND TIME

> And whatever will break on our routine, let it break!
> Many a house has yet to be built.
>
> NIETZSCHE.

THE small parts of the universe are perpetually moving, and the denser formations of these parts are repeatedly being struck by the myriads of tiny particles darting this way and that. Billions of corpuscles stream against our bodies each second, but they come so uniformly that we normally are unaware of them even while absorbing their energies from every side. Light, heat, gravitation, and other invisible forces, balance their blows so perfectly that in this turmoil of energies large objects in this earth have no average tendency to move as wholes with regard to the earth. Bits of matter strike in at various speeds, and often in organized series, but they always impinge one at a time and deliver their energy-charges instantly. Let us think a moment about these blows against our bodies.

When a stone strikes a wall it is difficult for us to know what takes place. We learn something of this event, however, by measurements, by repeated observations of the changes that have resulted; but our instruments are imperfect and always require time for their functioning. When blows are delivered against our own body-organisms, however, *we* are the walls which are struck; we receive the shocks and can analyze them. The mind in its taut relationship with its body is associated intimately with the struck object, and it can perhaps form conclusions about the event as accurate as if the mind itself were the body-wall. Let us at least attempt to learn something of unit energy-transfers by considering the character of our own sensations.

In the preceding chapter we argued for the necessary

immediateness of the transfers of motion from solid particle to solid particle, basing our conclusion upon the doctrine, seemingly valid, that the unit-particle can neither be elastic nor contain open spaces. We contended, further, that an inconceivable appearance and then disappearance of mechanical energy must be postulated for the unit-collision unless its motion *is* transferred *instantly*. Let us now try to confirm this theory by observing the duration, or lack of it, of the collision with our own body—of those blows with which our minds are intimately and sensitively associated in a fashion later to be described. If, on self-analysis, we should discover that we have no prolonged appreciation of any single blow—of a blow *while it is being delivered*—we must acknowledge the probability that the energy of the blow is transferred to us *immediately*. Otherwise, consciousness of an activity would linger.

If, when unit-particle strikes unit-particle time is consumed in delivering the momentum, then the sensation as received from this blow, even while it is being delivered, should have a perceptible duration in the present. If time is consumed in the receipt of each of those units of momenta, which, when added together, cause all the acquired movements and rearrangements of matter, and all of our sensations, the mind should have protracted consciousness of the separate unit-blows causing the motion. The understanding would then receive its impression of each unit of energy through a distinct interval; and the sensation derived in the present from the unit blow would be appreciably extended in time. If, however, our mental appreciation make us admit that the time of delivery of the unit of energy is as immediate as thought itself, personal confirmation and support will then have been added to the theoretical conclusion already reached that no time is consumed in the delivery of unit-energy.

The more closely we consider our own sensations, the more willing we are to agree that extended thought about any sense-datum is possible only through memory. We acknowledge that our appreciations of happiness, pain, of all life-experiences, exist, not in the present, but either in the

remembrance of what has taken place, or in the anticipation of what is to happen. Except for our ability to chew the cud of old experiences, and thus to renew the history of what has happened, we could not have either our feeling of continuous sensations or the knowledge which we acquire cumulatively in experiences one by one. Except for memory, we could have no feeling of a continuously conscious life; but, blessed with memory, and having minds associated with physical bodies which particles may strike and change, and which our mind-powers may move, we obtain, reasonably enough, a sense of continuous, tied-together existence. This understanding of ourselves supports the theory that energy-deliveries may well be one by one instantaneous even though our thoughts seem to endure. A person without memory would doubtless have no extended appreciation of time—at least in so far as time referred to this organism in which the mind-power appears.

Mind-power, associated with a body which is the object of instantaneously received unit-blows, obtains its sense of protracted consciousness from the continued appreciation of the effects that blows *have* made on the body. This is possible even though these blows, and their transfers of momentum or motion, and the changes thus caused, are immediately past. After each blow the body appears in a new arrangement and with a new relationship of parts. A fundamental physical difference has appeared, and the mental force is capable of appreciating both the change in, and the nature of, the new environment to the extent that it is able to be conscious of matter.

The blow of an object is realizable only because *the physical effect is lasting,* and because some mind-power remains associated with and conscious of its physical organism. Not the act of transferring energy from particle to particle, but the effect of the transfer upon the physique, endures. The movements against our bodies creating a consciousness there —and bodily changes as well—are instantly received, and are developed as sensations in time by means of the mentality thus created. This is possible only because this mentality operates the body.

We do not hold the energy of the unit-blow for our lingering appreciation during the interval that both the motion and the matter are being received into ourselves. Rather, sensations extended in time are possible because the mental perceptions refer not to the event, *but to its result.* Sensations are due to the appreciation of the effects of blows; and they exist, and are appreciated, after the cause of them has ceased. The activity is instantaneously received, but the effect endures. It remains in the physical, and the body now offers a different resistance to the activity of the mental power living therein.[1]

An energy-delivery of the present instant cannot be caged and held by thought, for the present becomes the past as rapidly as thought can move. Except that our appreciations were derived, not from contemplations of activities, but from an understanding of the changed bodies which these activities have caused, our physical existence would nowise be realizable.

Memory, then, does not repeat to us the very blows—the effects of which later give us mental sensations—but reveals, even to our present mental activities, the physical changes that *have* taken place, stage by stage, and each without consumption of time. The waxen disc of our lives is finely dotted with innumerable pricks of experience, each instantly received but enduringly recorded; and our mind, through its activity, subjectively reviews these experiences, and thus becomes conscious of its past.

In this way, through energies received and their physical consequences within us, we are changed. An evolution takes place. The physical self is altered; neither mass nor contour is what it once was; transformations have brightened or

[1] The mind-power of men is largely subconscious. The conscious being as yet has comparatively little control of himself, or of his appreciations. Nevertheless, all the motions against our bodies have their wonted effects, whether or not these effects are later subject to conscious or subconscious appreciation. The conscious mind evidently regulates to some extent the possibility of later appreciation by it of the effect of a blow. A person reading intently, with conscious attention absorbed, does not consciously hear the music being played, and cannot later recall it. The music has impressed him, nevertheless, and its normal effect dwells in the subconscious part of him. The shunting-off of conscious appreciations of blows against the body to the subconscious portions of the brain has no bearing on my theory; it neither increases nor diminishes the total effect produced in us by the impulses of the sound-waves which the music represents.

tarnished, have added to or substracted from our bodily organizations; the sensitive disc has received blows, and has its recorded history of indentations and abrasions. These hills and valleys in the physical record are, to some extent, enduring realities, lasting long enough to be interpreted by a mechanism that later can be affected by the physical undulations and vibrate harmoniously therewith. The humming needle of the brain, let us say, fits these grooves, and plays a tune which mentality hears and interprets; and our experiences—always past as experiences—always associated in memory—are termed painful or pleasurable according to this interpretation.[1]

Memory exhibits to us the record of physical structure built by those fateful experiences of our past. When remembrance functions, we feel that existence is connected without breaks or open spaces. There seem to be no intermissions, no time of non-happenings. When the vibrating needle has been placed upon the indented disc, when the physical record is being revolved under the needle by a mental impulse, then we *remember*. We are listening to the music of our past, sad or sweet. But, unless there had been some change in the physical record since the last play of memory, unless there had intervened a blow from the discontinuous matter outside, unless there had been created a new mental impulse with the power and the volition to review the old record—that is, except for change, time, discontinuity, and

[1] As the mind-power of the organism interprets the effect of the movements of outside matter against its parent body, it is not strange that mental dissatisfaction should be displayed when the blows of outside matter have proved unduly destructive to the body-organism—and inharmonious therefore with any plan involving its further evolutionary life. Naturally, a type will be exterminated, and will drop out of the struggle, if the blows are too destructive to its physical organization. The blows of an abnormal environment may be ruinous to the hopes of a continuing existence for this person or for his descendants. Or, if the experiences are fairly normal, but are not satisfactorily met by a certain organism, proof is thereby given that this organism is inferior to others in competition with it for life and future existence. Sensations of pain, then, come with and from the mind's interpretation of blows which have caused bodily degeneration, or which have demonstrated inferiority to others of the same species, or which have proved that there has been inadequate adaptation to the experiences that are to be expected in every-day life; whereas pleasure comes largely from proof of superiority to the competitors struggling for the universal prize (life itself), and from indications of fitting harmony with the temperature, the moisture, the food-supply, and so on, of the material environment. In feelings of success and health we obtain a large measure of happiness; and these exultations are revealed as mental appreciations of evolutionary fitness.

mind-power—memory, so far as it relates to sensations derivable from physical effects, would be meaningless.

The response of this time-made chart to mental impulses reveals enough, however, to make our materialistic lives significant, conscious, and emotional. When this physical pattern of our history is retraced, we obtain the music of memory; and the realizations of what is now past, the associations of ideas of the past with ideas of the sensations as just received in the present, together with the deductions from this association of the probabilities and possibilities of the future, make real our conscious and temporal existences.

So unremittingly does the mental power take note of its physical body-organism, so constantly does it concern itself as active agent with the structural formations recording the past effects and changes, that our mental existence appears to be continuous. We well know that the mechanical changes themselves which make the physical aspect of life-experiences real, are separate, and that only mental power, created in the moment, and persisting continuously in the organism in a subjective relationship with it, may perhaps be regarded as offering us an example of continuity. The subjective reality of the mental seems to persist continuously through time, and the same is true of the objective existence of material inertia as a space-occupying entity, but the transfer of motion from corpuscle to corpuscle is instantaneous, and the relationship of moving matter with mind is in the same category.

David Hume said that in the world of experience life is only conjoined and never connected. If, however, the sensations derived from blows (as all sensations are) might be conceived as continuous, the motion of matter-particles against us must needs then have been unceasing. The newness of successive sensations is possible because a blow-created mechanical change has been experienced since the last mental review. The analogy of the cinema applies to all sense-data. Realizing the error in an assumption that any realizable matter-body is concentrated in solid formation throughout, we must deny continuity for any of the energy-deliveries affording our usual sensations. Physical experi-

ences are received in successive and tiny units of effect, which, one by one, are unrealizable, but this does not signify, as Hume believed, that there is no connection between mind-power and the matter of the universe. The intimate relationship of mind and matter has already been considered.

Because our physical bodies are impressed with the effects of intermittent and separately inappreciable blows, but because these separate blows when grouped through time and space create characteristic and appreciable effects, and because a mental power is associated with and aware of the characteristic physical effects as made by these different energy-groupings, the phenomenon of memory, so far as it relates to the body and its sensations and problems, is purely physical in one important aspect, and remembrance of this sort will vanish along with the unit of matter. However, the blows of matter from outside realms, their effects upon the physical body-organism, and the associations of these effects with the activities of mind-power, are all necessary if man is to have consciousness of the physical world surrounding him, and if he is to have memory of, and thus acquaintanceship with, its typical energy-events.

Mental appreciations of the records of past effects, together with reasoned expectations for the future as based principally upon mental interpretations of the past, and nothing of the mechanical which is time-consuming in the immediate present, occupy most of the conscious moments of people like ourselves whose lives relate chiefly to problems with the physical, and with whom planned thought largely pertains to the control of the mechanical environment. Nevertheless, Time as an abstraction, and Memory as a character, will serve no purpose and will have no reality for us when physical bodies and their problems have ceased to be. Just as extension in space will become unreal when the unit-particles of matter shall have all been transmuted, so will ideas of Time become unreal when the life of mechanical energy-associations shall neither be experienced by physical bodies nor considered by thought, and when the problem of the successful living of a particular body-organism in a

particular physical environment is no longer the problem of a particular mental power.

In our physical selves, then, we have proof that mechanical energies (the experience-giving blows of matter) do not partake of Time or Space in their deliveries of unit effects. In thus concluding that the feeling of prolonged sensations are derived from mental appreciations *now* of *old* happenings, and never from the passing events themselves, we have added support to the theory that mechanical energy passes instantly.

Mind-power is unable to obtain important knowledge, or even protracted consciousness, from a single mechanical event. Why is this? In the first place the single event is immediate. Its energy is transferred either instantly as a whole, or in instantaneous installments. Therefore protracted consciousness of its effect upon another bit of matter is impossible. In the second place, the single energy-delivery affords none of that multiplicity of design of energy-patterns (in space and time) to which our usual knowledge relates. In the unit blow we obtain conscious knowledge solely of inertia and motion. We cannot continue to think about a unit expression of moving inertia for there is no variety in it to be thought of. It has no relationships. The reality of one unit blow is the same as that of every other at the same relative speed. Thought, therefore, or at least that kind of thought which affords us knowledge of the more important life-sustaining aspects of our environment, refers not to the properties of the unit event, but to the characteristics of multiple events as compounded in space and time of many separately instantaneous unit events. No link of the chain of this mechanical series of events affords us knowledge typical of our general relationships with matter, no link of this chain is itself extended in time, and each one has completely passed by (and, except for memory, would no longer exist for thought) at the time when the successor-link has reached the place where it too may deliver its effect.

Yet, most of our knowledge refers to relationships as compounded from a series of unit events separated by time-and-space intervals. *Composite* knowledge of this sort,

knowledge of the series, is derived solely from memory-processes. Time, therefore, has no part to play in the mechanics of this knowledge-giving process, for only the single immediate blow and its equally instantaneous effect (both of which, of themselves, afford no knowledge) are subject to mechanical definition and classification, and each of these is instantly accomplished and done with. The mind-power referring to the *present* mechanical activity, therefore, never acquires new knowledge from it, for the single happening, the unit event which alone is expressing itself in the present, affords none. The knowledge that is valuable, the knowledge even of the routine of change, is derived from the mental interpretation of the mechanical significance of a composite energy-series, and, therefore, is acquired from that which is past, and which, as a mechanical activity, does not exist in the present. The realized energy-series as a whole exists in the present merely in the form of its effect, its static result, in the form of a change that has occurred and that still exists. Certainly it does not exist now as a new form of energy then real because being expressed from the outside at that time.

The mind never "knows" even that change that makes the mind-power until it is past—until the mind-power is made. It is certainly impossible that steam should be able to recognize the water from which it comes until this water has actually become steam. Only because the blow of the particle of matter which is connected with mind-power has a lasting effect on the physical body, only because it has affected physical as well as mental reality, can this sensational effect be interpreted by the successive impulses of mind-power which are created in the body from moment to moment. From these mental activities with a changing body we obtain from the past those present sensations and appreciations which make us conscious of living and of having lived. We are mentally conscious, too, of only that rearrangement which is retained in our body organization. Our consciousness of the past, that which we make use of in forming judgments, always refers to the internal physical change, and never directly to the outside source or cause.

Because the alteration of our body is a repeated process, and because the mental flow from the body is correspondingly a repeated creation, we are enabled to have consciousness of past physical impressions and their associations. That we are enabled to do this without having consumed time in the acceptance of motion from the striking particles is the contention of this chapter. Recurring consciousness, and mental power continuously present within the volume of our bodies are possible, logical, and to be expected, even though the blows of discontinuous matter-particles are received and recorded instantly in the body-matter. No happening mental or physical, has yet made us suppose that the transfers of energy from particle to particle are other than instantaneous. In fact, the more we inspect the reality of mental and physical events, the more we are sure that time cannot be consumed in the passing of mechanical energy. Present judgments emerge logically from old events, even though those impressions are received instantly; and this tying together of Past and Present through the active mediumship of a mental current which flows in a stream from a body physique out of which it is intermittently being created, and of which it is from moment to moment conscious, has both utility and practicability.

Time, in its physical aspect, refers, therefore, only to the duration of the physical chart over which mental memory hovers. The mind participates in a series of sensation-producing activities, each without appreciable time-interval. Before a sensation may be grasped, it seems to have passed. Time, so far as we can judge, refers to the duration of the physically inert, perhaps to the activities which create the energetic mental, probably to the continuous presence of the subjective mental power in every life-organism, never to the energy-transfers of the physical.

Thus, when we refer to the physical aspect of sound, we realize that the last note of the organ lingers because the air is still vibrating in the tubes, and because the physical undulations of the note are not ended. If one breaks the electric connection of a radio set, the sound ceases as quickly as the time required for the last air-vibration to reach the

brain. Because of the physical apparatus of the ear, even this may be a distinguishable interval, but, when this last vibratory motion does reach the mind, it delivers its effect instantly, and immediately thereafter no sound-sensation is to be appreciated except through memory.

The blow of a single particle of matter makes the unit-impression. This blow is the unit of sensation, of acceleration, and of energy-delivery. If it were possible to appreciate the *present* of any single sense-impression while it was occurring; if the present sensation did not always immediately become the past; if memory were not the inevitable resort of the conscious appreciation that leads to knowledge; if the opposites of any of these things seem reasonably true, then, and only then, might one contend that unit-momentum consumes time in being transferred to another particle.

Hegel—as interpreted by Professor Josiah Royce—put this idea clearly when he said:

> I know whatever *is* here and now for me. Yes, indeed, but *what* is here and now for me? See, *even as I try to tell, the here and now have flown.* I know this note of music that sounds, this wave that breaks on the beach. No, not so, even as I try to tell what I now know, the note has sounded and ceased, the wave is broken and another wave curves onward to its fall. I cannot say "I know." I must always say, "I just knew!" But what was it I just knew? Is it already past and gone? Then how can I now be knowing it at all? One sees this endless paradox of consciousness, this eternal flight of myself from myself. . . . All that I know, then, is not any present moment, but the moment that is just past, and the change from that moment to this. My momentary self, then, has knowledge in so far as it knows, recognizes, accepts, another self, the self of the moment just past. . . . This is an old paradox. . . . [That I] can only review my past mind is the reason, for instance, why I never precisely know that I am happy at the very instant when I am happy. . . . It is my memory, that but a moment since or a while since I was joyful, that constitutes my knowledge of my joy. . . . Each one of

> us, however, is *now* only what hereafter he *shall* find himself to be.[1]

There is no paradox here, but merely a fact about energy-transmission which may be reasoned from. If Hegel had considered that these sensations to which he referred all came from the blows of matter, and that his mind interpreted, not an old idea but an old physique, he would have perceived that the physical energies were delivered instantaneously. This admission, however, would have disproved parts of his other theories, and have led him to different thoughts about life and the universe inclosing it.

On considering the meeting of two solid particles, reason concludes that the transfer of the "charge" of motion and energy is instantaneous. On observing the experiences within the body, reason again reaches this conclusion. The phenomena of our bodies support the evidence of the external world that time does not participate in the transfers of unit-motion. And yet, if this be true, then time must be similarly absent in the accumulation of these unit-effects into velocities, however great.

It might be possible to rest our argument here, and conclude unhesitatingly that the "charge" of motion passes from particle to particle instantly; but if we did so we should leave the way open to criticism on the part of those who might contend that this hypothesis is contradictory to the conventional mechanical laws of energy-transmissions, the general dependability of which, they say, has been proved, and which, therefore, they contend, must be correct. A new theory must accord with acceptable facts, and, as the usual formulas do give approximately correct results from day to day, the assertion that our theory does not accord with them would make it lose caste immediately unless, perhaps, we are able to defend ourselves by pointing out the inaccuracies of these formulas when referred to unit-events. We shall anticipate this criticism, therefore, by proving, not only the essential incorrectness of the old principles, but the reasons for the accuracy they do display. We shall demon-

[1] Josiah Royce: *The Spirit of Modern Philosophy*, pp. 204–6.

strate that these formulations, in their relative accuracy when referred to composite series of sensational events, and in their essential inaccuracy when referred mentally to unit events, really afford proof of the correctness of our view. Indeed, it would strengthen our case if we could show that the theory of immediate energy-transfer has no important conflict with the old formulas for ordinary usages, and that it is even applicable to phenomena regarding which the conventional formulas have proved misleading and incorrect. We shall consider these subjects in succeeding chapters.

CHAPTER X

INCORRECT USES OF SPACE AND TIME IN PHYSICS

The Love of Truth in the abstract is probably the weakest of human passions; but truth when attained ultimately gives the fulcrum for a reconstruction of the world.

LESLIE STEPHEN.

IN identifying the place of Time and Space in world-relationships let us consider some of the data of physics. First let us see what happens when a force (F) begins to act on a body weighing W pounds for a certain number of seconds (t), when the body lies on a horizontal and frictionless surface. It is the conventional belief that "the first result is motion, at a constantly increasing velocity. The relation between the elapsed time and the velocity is determined by experiment. The velocity (V) varies directly as the time (t) and as the force (F), and inversely as the quantity of matter (W)."[1]

Here is one of the first generalizing assumptions of mechanics, and here a fundamental error enters. On account of *experiments* with masses composed of enormous aggregations of unit-bits of matter it is stated that the velocity of a body subjected to a force depends upon the length of time that force acts, but we assert a contrary principle of reality—namely, that the force of the blow of the smallest bit of matter (which is the unit of all force, of all influence to motion, and of all acceleration) is transferred without time-interval. These tiny particles strike one at a time, for they are separated in space. Each being solid it must deliver instantly to the struck particle a part of its "charge of motion." Thereafter there can be no acceleration of the struck particle from the action of this striker.

[1] William Kent: *Mechanical Engineers' Pocket-Book*, 9th ed., p. 525.

Professor William Kent says: "If two inelastic bodies collide, they will move on together as one mass with a common velocity. The momentum of the combined mass is equal to the sum of momenta of the two bodies before impact." [1] It is supposed that no momentum is lost in the contact of the two inelastic bodies. This means that neither time nor space is consumed in maintaining the contact nor in the delivery of the force. It is thus admitted indirectly that the energy-transfer between the smallest particles is immediate, yet those law-givers whose rules virtually contain this admission, do not thus interpret their facts. Based on working rules experimentally derived in gross relationships, and improperly interpreted, a concept has entered mechanics (and thence into philosophy) which is fundamentally unsound. If no time is consumed in the transfer of energy from one inelastic body to another, and if all the larger structures are composed of these smallest or unit-bodies which are rigidly inelastic, then time cannot participate in any energy-transfer as due to contacts. If, therefore, there are no mechanical forces except those derived from the contacts of matter-bodies, Time does not participate in any expression of energy. Nor can changes in Time create changes in energy-delivery, as Einstein assumes.

If the smallest bits of matter are symmetrically spaced in the structure of the composite body which is striking, the number of particles which approach and reach the place for delivering their momenta to the struck body will be almost exactly proportional (certainly closely proportional, and exactly enough for all practical purposes in gross calculation of averages) to the duration of time that elapses after the first contact is made. This principle is true of a series of contacts, but it signifies nothing as regards the time required for energy to pass after the contact of two rigid parts has been established. If, however, no time is consumed in unit-energy-tranfers, it cannot be seriously contended that time is used in transferring any unit energy-deliveries. The addition of a million zeros is still zero.

Because duration is consumed in the motions of bodies

[1] *Ibid.*, p. 530.

through empty space; because gross experience with large masses composed of billions of small separated particles prove that proportionately as time passes more of the energy of these parts is transferred by contacts; and because certain practical advantages accrue from the assumption that force-delivery is a function of time, and that weight-force and other forces of "attractions" are continuous, we are, for these reasons, perhaps, justified in using an averaging formula for the events in gross, but we are not justified in accepting these practical advantages of averaging formulas as proofs of the philosophic soundness, and of the universal application, of our working rules. We should not suppose, for instance, that our conventional formulas accurately apply to unit-events. Yet we have done exactly this. Relying upon the experimental practicability of the averaging formulas which include within their limits both the time of approach and the time (if there is any) of the actual transfer of force, we have reached invalid conclusions concerning the principle of force-transfer. Physicists have concluded, indeed, that the velocity of every body increases exactly in "proportion to the time the force acts against it," whereas one would be nearer the truth in asserting—if all forces are really discontinuous, as we believe—that the "time the force acts" (all of it) is of no duration whatever. This becomes clear when we realize how the granular composition of structures must effect their force-deliveries. We perceive then that between the separated blows of a composite body there will be relatively long periods of time during which no contacts occur, within which no force acts, and within the bounds of which there will be no change of velocity.

But we have become confused. We have assumed that forces such as gravitation and magnetic attractions are continuous, and that they deliver energy in exact proportion to the passage of time. We have therefore believed that the accelerations caused by such forces are continuous. This has given us the unreal concept of continuous force—even of a continuous force that is limited. We have then transferred this erroneous concept, and have used it in our interpretations of other forces which, because of our coarse per-

ceptions, we treat only in gross. We have measured all forces in terms of weight-force. We have thus fallen into the easy error of supposing that energy-delivery can properly be formulated as a direct function of the total elapsed time. We have then relied implicitly upon the fundamentally erroneous mechanical formulas connecting elapsed time with force-delivery in exact ratio.

Perhaps we were partly justified in assuming that the blows of pieces of steel or stone delivered force during the total time that acceleration was being created. At least this so appeared in those days when such bodies were regarded as essentially solid, and when our practices only related to large composite effect subject to averaging with close approximations to accuracy. Modern knowledge of atomic structures, however, proves the fallacy of thinking that all the time between the beginning and the end of a delivery of force by a composite body might be consumed in the transfer of the force. On the contrary, the more we inspect the reality, the more we philosophize about unit-force, the more we can be assured that *none* of the time is consumed in the force-transference. And, likewise, the more we think of an "attraction" such as gravitation, the less likely we shall be to think that this, or any other "pull," could be continuous, or different from the reality of its equal and balancing opposite—a series of separate "pushes." The philosophic difficulties involved in the concept of gravity as a continuous force are referred to in the Introduction. And the more one studies physical nature, the more he will be convinced that there is no force-action at a distance, no "attraction" or "repulsion." The idea is incompatible even with physics. Every force-demonstration is viewed more logically as due to the discontinuous blows of inert and solid particles.

If one abandons the idea of continuous "attractions" and "repulsions" he must concede that continuous acceleration is unreal also. If there is no continuous force there can be no continuous influence of a force. Regardless, however, of our present concept of "forces-at-a-distance," whenever we treat with forces known to be discontinuous—such as the

energies delivered by the air-molecules against the sail of a boat—we must admit of these striking bodies that almost all (if not quite all) the elapsed time is consumed by the air-molecules in reaching the point of contact with the molecules of the sail—and not in delivering the force there after arrival. If it supports other beliefs better, we may suppose that *all* the elapsed time is consumed in translation through empty space, and that none of it is used in the actual surrender of motion. Having done this, we shall perceive that our working rules have lost none of their validity—so far as they are valid.

If we should then assume that gravitation is not caused by continuous "attraction," but rather that it is due to the repeated blows of enormously rapid and very tiny corpuscles, we might discover that the force of gravity (the force known as weight) is still subject to gross summarization in approximately the same formulas as used in physics to-day. If gravity were taken as due to a succession of discontinuous "pushes" of finite proportions, rather than as an unreal continuity of unrealizable "pulls" without units of conceivable proportions, the formulas would be altered slightly, perhaps, but they would then be more accurate than the old for every condition, and we would have made a great advance in adopting a theory applicable to situations which the present theory fails to interpret.

It is easy to understand why and how physicists have been lured into a misunderstanding. Their ideas have been based upon necessarily inexact and incomplete knowledge, and upon erroneous but natural deductions from working rules which have been highly prized chiefly because they have proved practical. In fact these rules have been developed only from gross experiences of a certain particular kind. They therefore could not be supposed to apply to other types of events. They are the simplest and most obvious formulas that seem to translate composite relationships with comparative exactness. The formula associating the discontinuous forces of the blows of separated matter-bodies with total elapsed time—as if the velocities acquired from the contacts were directly proportional to "the time the force acts"—

is fairly accurate in so far as it relates to the usual energy-deliveries (as a whole) that we can appreciate—but it is approximately accurate then only when it is factored. When this factoring adjustment is made, the formula approaches the reality of the experience closely, but it does so then only because it averages a succession of many intermittent and regular events with fair accuracy.

The velocity of a body which receives its motion from the blow of another moving body (such as the motion of a pile under a drop-hammer, or the acceleration of an automobile from the separate impulses given the piston) cannot be deemed to be created in some proportion of the total "time which the force acts." If the force of the drop-hammer is received from the momenta of the separate parts of its structure—as if these parts were separate drop-hammers themselves—just as the blows of the separate air-particles constitute the total pressure of the wind on the sail—and if each of these separated and solid parts requires time to approach, but none to deliver energy, there is no time during which the force does act. Consequently the formula associating the total elapsed time with the delivery of force is meaningless philosophically, and is meaningless in practice except when factored, and has value then only as an approximate averager of a total duration which includes both events and non-events, and only if the series of blows is fairly regular. The formula is incorrect, however, and is particularly harmful in that it carries an erroneous implication as to theory.

The total elapsed time of the pile-driver includes its intervals of rising and falling, and this principle applies to each of the separate parts of the pile-driver. In no case is time consumed, so far as we can tell, in actually delivering the momenta when the ultimate solids come into contact, and, until these contacts are attained, no appreciable energy *is* delivered. A formula for the average of happenings of sufficient regularity which includes the total elapsed time, as we have said, is highly practical. We average events even when we state the energy of one stroke of the pile-driver as a function of extended time; but we are more apt to realize

what we are doing when we calculate the total energy delivered over a relatively long period of time. If the pile-driver falls once a second, we can assert that from the beginning to the end of 999 seconds of its force-delivery the force of 1000 blows will be delivered. This is the useful averaging data; and the statement that one blow of a thousand foot-pounds is delivered in one second is an equally useful generalization. Nothing in this utility, however, justifies us in thinking that time is consumed during the delivery of any of the force of the hammer; and still less should we argue that an infinite force would be required to give the least velocity without the passage of time. Our formula associating time, force, and velocity has led to just this last unreality. We have allowed its generalized practicability to distort our conception of truth.

The statement that no time is consumed in force-delivery does not affect everyday mechanics. The old formulas prove adequate for the usual experiences; and the slight changes necessary to make them conform to the new theory proves particularly important only when referred to the more particularized event, or in respect of tremendous velocities—that is to say, only in cases where the new ideas are obviously needed. Since the new formulas will be found also to apply more accurately in dealing with phenomena which could not be treated by the old rules, the change should be welcomed, for both practice and reason will be better served.

The old theory that force and velocity may be formulated as a direct function of time might be true, as we say, if force-delivery were, or could be, continuous, but the universe would not be then as it now is. Are there, however, any continuous forces?

The parts of the elements of the earth are invariably separated by open spaces. Hence, energy by contact cannot be delivered continuously. But, perhaps, it may be delivered continuously by attractions or repulsions at a distance. Perhaps even the energy due to the motion of an object might be delivered by an object in part in advance of its direct contact. In such case, however, this advance-receipt must somehow be subtracted from the energy transferred on collision

for there would otherwise be an unaccountable creation of energy as due to motion. Now careful experiments have proved (at least experiments with certain of the typical smaller bodies) that there are no such attractions and repulsions between the parts.

The physicists admit, for example, of a theoretically "perfect gas" that there would be no trace of forces operating between the separate particles when either expansion or contraction takes place. Yet if a balloon filled with such gas were thrown against a wall until it mashed to the point of rebound, the momentum of the balloon would be typical of all force-delivery by collision. If, however, there is no appreciable repulsion through space from particles as against one another, or as against the wall prior to direct contact, the total energy of the balloon against the wall must be delivered solely by the blows of its separated particles. Continuous force-delivery by the mashing balloon in proportion to the passage of time is found, therefore, to be mythical; and the formula which postulates it is unreal.

And that which is true of the balloon applies equally to all body-groupings, whether gases, liquids, or solids. In all cases the assumption of continuous force-delivery by contacts may be useful as a formulation, but it is fallacious as a principle. Certainly, the "thing-in-itself" cannot affect the regions outside of itself differently (here as compared to there) merely because different amounts of empty space happen to intervene between the separated units, or because here the relative velocity of the average part has been decreased slightly.

Lead and hydrogen gas differ in structure, not in basic composition, and the general principles governing the internal relationships of these identical parts cannot be affected by the fact that the structure as a whole is of this or that type of formation. If there is sufficient rise in the temperature of a piece of iron it will dissolve into an invisible vapour, but no attributes of the same smallest bits of matter composing the solid and the gas are affected intrinsically by this change in the average separation of parts. The proof that the force delivered by the motion of a near-perfect

gas is intermittent should therefore prove to us that all the energy of the striking cannon-ball is delivered intermittently. In the case of the so-called solid it is merely more difficult to detect the intervals between the contacts of parts.

We have here been steadily reinforcing the idea that not even gravitation nor electrical magnetism, is a continuous force-expression. If the earth should be influenced to leave her orbit and strike the sun, why should she express force with reference to the sun prior to or after the contact. Certainly she could not affect the sun in advance of contact unless her motion through the pool-formation caused disturbances in the pool which reached the sun ahead of the earth's contact. If the earth is composed of the same ultimate particles as the "perfect gas," and if the parts of the latter display at a distance no repulsions nor attractions for other neighbouring particles, why should the same type of particles, merely because collected in denser groups, display such unreal types of force? According to conventional theory the earth constantly attracts the sun. She is thus supposed to be able to exercise an energy-influence as she approaches the sun which is exactly opposed to that which she would deliver on contact. Thus the force of an "attraction at a distance," if it were real, should itself alter the conventional formula of force-delivery on contact. If, however, those energy-effects which we have been inclined to view as due to continuous "attractions," are really the expressions of the intermittent momenta of invisible particles (so tiny, so close together, and so swift that we have failed to realize their presence) where is this continuous force to be discovered which the working rule postulates when it associates force and time in direct and exact ratio with velocity?

Even the force of weight, the unit which physicists have selected for measuring all force-expressions, breaks up under this different theory into discontinuous and granular impulses—pushes instead of pulls. If we thus change our outlook the facts will not change, the rules will still be practical where they have proved practical, but many inconsistencies will disappear. Our rules slightly modified will become more

universal. We now know, too, that even the electrostatic charge is granular.

Cohesive force—another variety of the supposed action at a distance, and the mysterious maintainer of structural formations—is to be regarded, then, not as a type of attraction of part by part, but as the result of a delivered energy from the outside—a pressure due to the blows of invisible matter-bodies. The nature of the force-principle which originates this pressure has already been described. The limited universe of matter represents a combination of motion and restraint—opposed but limited tendencies. From the action of these opposites there arises an equilibrium, and this averaged uniformity of condition obtains from bound to bound. The force which moves and restrains matter is the source of all the permanencies of the atomic structures and of all the more or less permanent relationships exhibited by the elements. Just as the whole is restrained to a limited formation, so are the separate groupings within the whole subjected to incessant motions combined with definite restraints.

All grouped structure, then, may be regarded as inert as wholes when averaged for a certain time in relation to the average volume of space that they exclusively occupy; but only because the parts which compose them are inert, and because the groupings, as wholes, do not express attractive or repulsive force into the spaces outside their bounds. These groups are composed of lumps of dead matter, and they (like their parts) obey unfailingly the force-principle which both moves and restrains them. Matter starts to move solely from the power of a mental will. This "will-to-move" may be received directly (at bounds of the universe), or indirectly—that is to say, by contacts with other matter-bodies moving within the universal sphere. The force-principle maintaining the coherence of the whole, by being passed on and transferred from one material particle to another, operates in every material structure wherever situated. Here, in these interior formations, this principle of restraint has long been observed; but it has been misunderstood, and restraint has been regarded as emanating from a force of "attraction" acting from the inside of matter outwardly—even

into the infinite depths of emptiness. This concept, the reverse of the true one, has given us ideas of "pulls" where only "pushes" are real, and of uninterrupted influences in a world wherein all force-expressions are granular.

We have misjudged the source and nature of motions, and of cohesive structure. We have been inclined to regard matter as attracted into its fairly permanent formations by forces emanating outwardly at the very time that these objects are supposed to be drawing other bodies inwardly. We have then thought of these imagined forces as continuous, and have prepared rules to average their effects into supposedly homogeneous (and yet every unit is virtually discontinuous) wholes. And, in support of this unreasonable philosophical concept and mental arrangement, we have made these formulas more practicable and have brought them closer to the reality of the postulated continuity by arbitrarily adding limiting factors—as though a real continuity could thus be factored into a limited discontinuity. In this way we have been led to suppose that it was reasonable to believe that a continuous force should express less than infinite energy. Having gone thus far in our ingenious attempts to obtain practical results from erroneous ideas of reality, we have then taken as our unit of all force the supposed "attraction" of the earth for a certain amount of mass on its surface. And this "pound" of force, as it is called, is supposed to deliver a *continuous* force-influence. Why not? Certainly our instruments cannot detect the blank intermissions!

As the next step, this pound-unit was introduced into the formula associating force, time, and acceleration, and this procedure was found (so far as was then known) to give dependable results. The factor for the rate of acceleration of a falling pound of weight was ascertained by experiment. This supposedly continuous force was thus reduced to a workable and finite constant. The "pound" was found to be a thoroughly practical unit. Whenever a pound of weight fell at relatively slow speeds its falling energy, when transferred to another mass, could be depended upon to give a certain velocity within a certain time to this mass when

sliding on a horizontal and frictionless surface. This, then, was the routine by which the formula associating force of supposedly continuous "pounds" with mass, time, and velocity was derived. The formula was then used to measure all forces—even those known to be discontinuous. The rules worked, so they were not questioned, but, all this time no particular consideration was given to the philosophical difficulties. As a final step, the scientist suggested that philosophy should correspond with these practical working rules, and, alas, the philosophers felt constrained to subscribe to principles thus supported by experience. This has been the road we have followed. It is not remarkable, therefore, that our ideas have become confused. Naturally, also, we reached unreal concepts of force, of matter, of time, and of space.

Our present formulas must be recast for the exact summarization of energy-transfer, and this is especially necessary when we treat of the unit-relationship.

We complain, however, not so much of the percentages of inaccuracies of the averaging formulas in usual practices as of the deductions drawn from these incorrect statements of principle. Because the generalized formula which associates time, velocity, and force in one equation is approximately accurate for composite experiences, the physicist is satisfied to accept deductions concerning fundamental principles that are contrary to a more generally developed reasonableness. Scientists have assumed that continuous (though limited) energy is a fact, and think they are surely right in associating time with the receipt of motion. If we are now able to disclose the inconsistencies of these formulas, it may help us to prove the contrary hypothesis—namely, that time is not consumed in any force-transfer; that all energy is delivered by unit-blows; that these unit blows are invariably discontinuous; and, therefore, that the idea of a continuous force, whether regarded as an "attractions" or otherwise, is erroneous.

One of the mechanical formulas measures the kinetic energy of a striking body in terms of one-half the product of its mass and its velocity squared. Still another describes momentum as the product of mass and velocity. The signifi-

cance of these two different formulas, both involving concepts of force, mass, and velocity, will be treated later. The simplest of all mechanical formulas states that a body moving at a constant rate of speed (V) in empty space will move a certain distance (s) in a certain time (t). This formula is sound, for no force is present here to interfere with the uniform velocity (V) already established. When force *is* actively present, however, the velocity of the moving body (not then moving in a void) will not remain constant. Acceleration will occur, and the velocity will increase (intermittently) as time passes.

If, however, the velocity increases with a regular addition of speed each second, there is another type of *average velocity* (V), one that obtains through any certain distance (s) through which the accelerating body moves. The distance (s), as traversed by the uniformly accelerating body, may be computed in terms of the average speed of the whole time-interval.

The symbol, V, is thus used to represent two distinct principles—the first being the uniform velocity of a body moving in a void through a certain distance (s) in a certain time (t). Here the relationship may be formulated properly as s equals Vt providing the units of distance and time are properly chosen. V is also used, however, to represent also the *average velocity* of a uniformly accelerating body which starts from rest, which travels through the same distance (s) in the same time (t), and which has acquired at the end of the time (t) a velocity of 2V. In this latter case it is said, too, that s equals Vt—when V represents the *average* speed. This statement, while true of the whole when we regard it as generalized and properly averaged, is not true if force is really discontinuous. Indeed, it is not intrinsically true of any section of the whole. Nor can the edges of the whole space (s) or whole time (t) be accurately determined for averaging purposes in formulas. Furthermore, only numbers can be multiplied, and if force is not divisible into units, it is not subject to discrete numerical formulation.

Let us suppose that accelerations are received at the appreciable intermissions of two inches. The formula correctly

applying to this situation will be the same in principle as that applying to intermittent intervals too tiny to be appreciated. A body will then start from rest at the initial velocity (V), as given to it, and this velocity will not be increased until the body has moved two inches. The velocity is doubled to 2V, let us say, at the end of two inches, trebled to 3V at the end of four inches, and so on. Certainly, for an intermittent acceleration such as this the generalized formula is incorrect, for, by its use, we could prove that the velocity was greater than the initial speed when the body had proceeded one and one-half inches, whereas the fact that no acceleration is added for two inches of movement prevents this from being so. The formula, therefore, which associates accelerating velocity with time and distance in a constant ratio is incorrect in its particular parts—unless, indeed, we can be sure that the force in question *is* continuous, and does give continuously accelerating velocities. As we are unable to conceive, however, that there is any continuous force, we are convinced that the formula is universally unsound; and we therefore credit it with usefulness only as an approximate working rule applying only to gross averages.

Relying on the same kind of reasoning, however, and basing the formulas largely upon incorrectly interpreted experience with very large multiples of the unit of mass as acted upon by gravitational forces—experiences wherein our relatively crude instruments have been unable to detect the fact that the forces acted intermittently—we have developed the erroneous principle that force (F) may be placed in a mathematical equation as an exact function of time, weight, and uniform acceleration. The principle that force (F) multiplied by time (t) (based on the assumption that abstract force can somehow be multiplied by abstract time) equals the product of mass (M) by distance (s) is thus derived and accepted as if absolutely sound under certain conditions, and we are then led directly to the assumption that a gross expression of force, (F), may be continuous and also directly proportional to time and space. Here, the error of judgment has entered the formulation.

Still another formula has been derived which purports to

connect force (F) with distance (s), weight (W), time (t), and the uniform acceleration of gravity (g), in a relationship supposed to be of general validity. It reads: s equals Ft^2g divided by 2W, and its derivation can be obtained in any text-book on physics. It is derived as the combination of these other formulas which must themselves be unsound if there is no continuous force.

Mechanical laws have not been founded on general philosophic principles, but upon rather gross experiences in certain particular kinds of environment. As thus developed, they seem to conflict with final reasonableness, as well as with the more particularized knowledge obtained only through a general philosophic interpretation of what must be. Since these working rules represent purely experimental data gathered in specific fields, the universality of their application can only be surmised. There is, therefore, no justification of the claim of the old school of physicists that they possess any ultimate or final truth—or that they ever are exactly true. Indeed, values have been transferred from one equation to another which could not thus be properly transferred, for different meanings and relations have attached to the same symbols as used in the two different equations (or statements of relationships), and this difference of reality has prevented the values of the symbols, when transposed into the new relationships, from being exactly appropriate. Faith in a working rule must end when we have departed from the conditions under which its laws were derived, and no interpretation can be depended upon to apply to conditions so tiny that we have never been able to perceive them —and particularly is this so if the interpretation is contrary to some principle of general reasonableness.

No mechanical law has been formulated from experiments with the smallest bit of matter. All have been derived from observations of rather large composite matter-groupings. Hence it appears that the only approximate usefulness of our present working rules is limited to the balanced and composite groupings of the usual environment. And, correct inferences cannot be drawn from these as to the true association of Force and Time.

We have put Time into our formulas as though it related to the actual passage of energy, or motion, as if all force-demonstration could be measured in terms of weight, and as if all weight-force were continuous through time. Then, after making these errors, and believing ourselves justified because the formulas containing this time-factor have proved fairly accurate, we have thought that these laws told us something about the nature of the unit-transfer of motion. Of late, however, we have identified bodies very much smaller than those of our former experiences. We are not inclined to believe that electrons are the smallest bits of matter, the final inelastic units; but it interests us to note that, as might be expected, the generalized formulas for kinetic energies have proved inaccurate when we have attempted to use them with reference to these tiny particles when moving at their characteristically enormous velocities. This seems to prove that the conventional theory of the nature of force, the relation of time to force-transfer, and what might be called the philosophy of physics, is at fault—even in practice.

Occasionally a thinker like Herbert Spencer considered the collisions of inelastic particles of matter, and was unable to conceive how time could possibly be consumed in the passage of energy. When, however, as in this case, reason seemed to conflict with what appeared to be proved fact, the scientist has thought it necessary to deny reason and to accept the supposed experience. The formulas have worked so satisfactorily that they were formerly held to as universal principles of precision. Recently, however, more accurate experimenters, practical men still dealing with experimental facts rather than with theories, were able to formulate the energy required to give the electron its enormous velocity. Here they were not treating with large, slow-moving composites, and here they encountered formula-defying results. These practical scientists then found themselves uncertain and confused. When their trusted formulas failed to give results corresponding with actuality, it seemed that the Gibraltar of mechanics had crumbled away. In this predicament the physicists knew not where to turn. They were unable either to account for the defects of their mechanical

principles, or to revise them to fit the new practice. Many of them, indeed, still believe that their old ideas and formulas are infallible, while others have adopted the theories of Professor Einstein, hoping thus to reconcile the irreconcilable. Thus they have accepted two distinctive views of the reality of substance, hoping apparently to harmonize them by the concept that inertial mass itself can be varied by relative motion. Yet, when the old mechanical formulas are accepted for no more than they are worth, and when the truth is accepted for what it is, the principle of inertial mass should return to its unity, and Space-Time as curved by the presence of unusual mass need not be regarded as the real cause of the general curvature that does obtain. Obviously, the formulas must be modified so as to be usable for the everyday experience at the same time that they are true of the most particularized state of affairs. When this is done, reason should be satisfied, the paradoxes should vanish, and relative time need not then be introduced as a principle capable of altering the reality of matter and of force.

Contrary to former ideas, Professor Einstein asserts that an infinite energy is required to give any mass a velocity equaling that of light (approximately 186,000 miles a second). He endeavors to explain this departure from the kinetic formula by his theory of Relativity. Certainly, so far as we have been able to discover, no mass moves faster in one average direction through long distances than the velocity of light. An electron is a typical mass. When moving at approximately the velocity of light it does not yield an infinite energy when it collides with another mass. Even so, we are quite willing to agree with Professor Einstein that an infinite amount of force-expression in its environment would not materially increase the speed of the electron. How may this paradox be explained?

The conventional theory of gravitational attraction displays its fundamental unreality here. No measure, however great, of this so-called "attraction" is able to increase the speed of an object when moving at the velocity of light. This is so, not because an infinite energy is required to give an object the velocity of light, but because the force of "attrac-

tion'' has no such limitless power of acceleration in empty space.[1]

Does not the atom of radium spout forth electrons at approximately the speed of light? No one asserts of radium that infinite energy is being used in creating this velocity. It is no explanation, therefore, to say that the earth's ''attractions'' fail to produce additional velocity in a body moving already at about 186,000 miles a second towards it merely because an infinite energy would be required to do so. The explanation is simpler. After accepting the concept that all motion is received by the blows of a moving solid against one that is relatively at rest it follows almost as a commonplace that a moving body cannot make another body move faster than its own speed in this direction. If an infinite number of bodies with an infinite potential energy were moving at 186,000 miles a second they could not drive another body at a greater speed. We may assert, therefore, of the force of collision that an infinite energy-expression cannot create a velocity faster than the speed of light, for this appears to be the maximum speed that matter moves in the universe near the earth. This speed cannot be increased by any known type of contact. The fastest runner when at full speed is not shoved faster by any crowd coming up from the rear. However much potential energy the crowd has, it can *be delivered* only up to a certain maximum amount. This is a very simple thought, but it dissolves the paradox.

An infinite amount of potential energy stored up in bodies moving at the speed of light cannot be delivered to an object to make it travel faster; but this does not conflict with the principle that when an object *is* moving at the speed of light it will deliver energy only in a direct proportion of its mass and velocity when it collides.

The hypothesis of Relativity is perhaps useful for those who believe that such forces as ''attractions'' are continuous, unlimited, and immediate. Relativity may help these

[1] Even according to Einstein, however, the rule of the invariant velocity of light (in vacuo, and in a certain direction) has its exceptions for the light ray passing a star like the sun is curved by the star's gravitational force (by the curvature of space-time, that is) and its velocity is thus altered by the action of the gravitational field.

persons to conceive how it is that "attractions" (however concentrated they may be, and however long they operate) fail to produce speeds greater than that of light; but if one will dispense with belief in "force-at-a-distance", he may perhaps dispense with Relativity at the same time. If he will surrender the idea of a force that is continuously causing acceleration, if he will admit that even a pound of force does not display a continuous power to create motion, he will simplify his concepts and his physics. Furthermore, he will understand why the formula for kinetic energy is fairly accurate for ordinary speeds but inaccurate for velocities approaching 186,000 miles a second. He will be able to comprehend, too, the distinction between the formulas of momentum and kinetic energy, and will realize why each measure of force is applicable for certain particular conditions.

Let us now summarize for a moment. We have been taught to believe that the amount of energy required to create instantaneous motion is infinitely great; but this belief was founded on our use of a mathematical formula of averages which carried this inference. The assumption is practical for ordinary experience, because particles which are separated, and which follow each other into contact, do consume duration in traversing empty space. Indeed, if the particles occupy symmetrical locations in the striking body (a necessary condition if the striking body is a self-contained whole) we may be sure that a certain gross amount of energy will be delivered by them during the interval between the beginning and the end of each moment. Time is not consumed, however, in the contacts of the different parts. Only a solid body can deliver a blow free from intermissions, and the smallest bit of matter is the only example of a perfectly inelastic solid. In all elastic aggregations (that is to say, in all composite structures) there are immense open spaces (relatively speaking) separating the different solid bits—and this emptiness must be traversed before the different particles of the series may reach the point of contact. The elasticity of the elements is illustrated by a star recently discovered in which the average density is said to be about fifty thousand times as great as that of the water of the earth. This means that

the average separation of parts on this star is only one fifty-thousandth of that of this earth, yet science knows that even in this star the empty spaces are enormously greater than the spaces filled with matter. Physicists virtually admit that no time nor energy is consumed in the contact of two perfectly inelastic solids; and yet the blow of the ordinary composite is merely a repetition of myriads of these timeless and spaceless contacts.

The mechanical formulas, therefore, should refer, not to the time and space involved in the *event* of energy-transfer, but to the time and space to be used by the parts in passing through the empty spaces up to the points of contacts. We do not ordinarily recognize or realize the blows of single particles, but we do appreciate the delivered energies when the single particle has been followed by myriads of others. Blow must follow blow. Enormous numbers must strike before our most delicate instruments of precision react appreciably. Tremendous swarms of unit-particles must strike us successively before we even consciously realize that we have been struck. In the midst of this succession of blows, time is consumed, not in the transfers of the separate energies, but in the movement through empty space of the separate bits so that each may deliver its minute and cumulative effect. And when we have accounted for the duration consumed in these movements through emptiness, the entire time of the energy-delivery is represented. No period is left for the passage of energy on contact. The formula implying the contrary is therefore incorrect.

Because no velocity less than infinite can make two particles (following each other) strike a so-called solid body simultaneously on a narrow front, because no force is really continuous, and because all motions are delivered by intermittent pushes, we are justified in saying when we treat of the usual blow of larger magnitude than the momentum of a single particle that infinite velocity would be required for two particles in a structure (if these particles are symmetrically disposed) to reach the struck body at one instant. On this ground it is correct to say of a world of balanced parts, wherein perhaps two particles never strike simultaneously,

that both infinite velocity and infinite energy would be required to add instantly to the struck mass more than the force delivered by a single particle. This is true, however, for reasons quite different from those advanced by most scientists; and the true reason does not conflict with the important principle that the unit of energy is always delivered instantly.

In the next chapter we shall discuss the construction of the atoms of the elements with which most of our experiments treat. This will throw some light on the phenomenon of radiant heat, and will support further the conviction that Time and Space are not involved in energy-transfers. In chapters XVI and XVII, we shall analyze some of the mathematical principles closely associated with the working rules of physics. A philosophy should be demonstrated both by theory and by practice; but the most satisfactory proof that Time is not consumed in the delivery of motion is to be found in the interpretation of mechanical principles. As this proof proceeds, it will more and more undermine some of the conventional beliefs. Conservation, ideas of "attractions", the theory of Relativity, may be dispensed with if one will but build his world upon a premise which gives reality and power to the mental or spiritual part of the dualistic universe.

CHAPTER XI

REINFORCING THE CONCEPT OF A UNIVERSAL ENERGY-EQUILIBRIUM

> Either it is a cosmos or a chaos driven together—but still a cosmos. But can a cosmos subsist in Thee and disorder in All?
>
> MARIUS AURELIUS ANTONINUS

THE formulas of conventional physics treat with the gross averages of conditions in relatively wide-spread fields—almost as if matter and its energy displayed neither edges nor intermissions in space and time. This treatment gives fairly satisfactory results when used in reference to the problems of every-day life, for man can have sense-impressions (and, therefore, measurable experience) only of composite bodies occupying a space enormously greater than unity. Not only this, but the relatively enormous body is viewed through a duration in which myriads of tiny unit-contacts create an almost uniform average of appreciable effect. Confronting this composite energy-situation (which appears to be the only one with which experience directly treats), reasoning associated with other viewpoints and properties seems to be capable of pointing out the error that follows this method.

These generalized formulas, arranged through judgments aroused entirely by composite experience, cannot possibly be used accurately to interpret the unit situation, or to indentify the edges of the composite event. Therefore, the philosophical conclusion arranged to conform with the conventional physics of gross experiences is irrational. In order to attain a sounder philosophy, and also a more accurate methodology in physics, we should rely upon a more general reasoning. Reason should supply us with a method of attaining knowledge which stands clear of the sense-interpretations as drawn from our direct (and, therefore, necessarily gross) experi-

ences. By the use of general reasoning we may perhaps be able to conceive our environment in its finer details. We may come to understand the nature of the constituent parts of the composite event, and may thus even determine where the exact edge of the composite *must* (of rational necessity) be. We may thus correct our present formulas and make them more finely accurate. We may thus arrange a scientific foundation upon which a correct philosophy may take its stand, and we may then find that this foundation offers support for religion also. Let us try to apply this method. The empirical method of acquiring knowledge is certainly unreliable.

We have already partly applied our concept. We have already attempted to identify the nature of the physical environment that must surround us if our generalized philosophy of a dualistic world is to be consistently supported by the facts, if our definitions of mind and matter, as broadly taken by reason, are to stand firm, and if the generalized formulas of mechanics are to prove fairly accurate in reference to our gross experiences of every day (as they are) while failing (as they do) when referred to the unit event.

We have postulated, as Reason almost compels us to do, that there is a general, even universal, mechanical energy-equilibrium permeating the material universe up to its very bounds. Only at the material limits, we claim, does the balanced mechanical aspect of the average condition of energy-equilibrium fail, and even here, where matter is missing on one side only, energy is manifested by spiritual forces acting *from* these regions of material emptiness. Hence, even at the bounds (*by* the very forces of the bounds, indeed) matter is restrained, and, at the same time, is endowed with specific volume and internal "cohesive" structure. Reason calls for this postulate as strongly as it calls for the separate reality of a mental force having reason.

But as we test this belief we must make it very clear that this concept of the energy-equilibrium itself applies (and then only in a general sense) to situations wherein many units of matter in motion are being considered, to durations in which the observation consumes many units of time, and to volumes

wherein the separately rather chaotic movements of many millions of unit-particles are being averaged by rather gross sense-perceptions. The postulate applies, that is,—and then merely with relative accuracy,—only to the generalized situations—such as those which usually confront the physicists. The conventional formulas, composed as they are from gross experiences, will naturally apply rather consistently (so uniform are the averages) to other similar composite experiences, but they are inadequate for dealing with the precise situation of the unit event. At this point, Reason, and not a sufficiently precise experience can tell us why this is so. No energy-equilibrium pertains to the movement of a bit of matter while moving through a void.

During this period there is no energy-delivery, but merely a change in the position of the potential energy; and this movement of the energy-potential would itself, nevertheless, if not reversed, destroy the average state of energy-equilibrium. Energy-balances, therefore, relate only to large views of the energy-situation, to judgments, that is, taken of energy-conditions as averaged through considerable time and space. Nor is the assumption based on the average condition that may be experienced, exactly true—even of this average.[1]

Here is a gross volume within which there are myriads of

[1] At the bounds of the universe, if it be finite, there is an edge to the material "field". On one side of the bounds there will be moving matter and on the other only an imponderable power. This is the invisible line so significant in its meaning. The "absolute" activity, on one side of it only, gives reality to the balanced mechanical energy-field between these bounds. No purely mechanistic theory which fails to introduce a creative (non-material) cause of "absolute" motions at these bounds as the source of the internal energy movements and energy balances can possibly explain the situation at the bounds of a finite universe. The physicists may guess at the situation at the edge of a certain atomic structure, and may arrange descriptive formulation of the atomic relationship that will describe it with fair accuracy as a whole (except that there will be no accounting for the internal reversed motions), but even this procedure fails to interpret the situation at the universal bounds. Even an Einstein theory (a purely mechanistic interpretation) must fail here. In his paper entitled "Cosmological Considerations of the General Theory of Relativity", Einstein wrote: "From what has been said it will be seen that I have not succeeded in formulating boundary conditions for spatial infinity." Then he goes on in this way: "If it were possible to regard the universe as a continuum, which is *finite* (*closed*) *with respect to its spatial dimensions*, we should have no need at all for such boundary conditions." What a struggle this is to translate the universe in terms of pure mechanism! How simple the explanation becomes if one is but willing to suppose that the power of mind over matter is a reality and a factor in universal doings!

unit events each of which must be interpreted by mechanical formulas quite different from those developed by the physicists. Here within the balanced cosmos are myriads of individualistic happenings which one by one appear to be almost chaotic. Indeed, they are proved chaotic and incommensurable to him who fondly expects every mechanical happening to follow his generalized laws, and who regards exceptions to his formulas as examples of chaos.

The more modern scientists have discovered that many energy-deliveries, heretofore regarded as continuous, can be explained only in terms of discontinuity. In some experiments they have reached the philosophic conclusions which are reached in general terms in the Introduction—namely, that a continuous force cannot be formulated, for it would be an infinite force. Planck explained the variation of the colours of light (as temperatures changed) in terms of discontinuous light-rays (the quantum-theory). Then Einstein noticed that another old-time mystery, the "well known anomalies in the specific heats of bodies," could be explained, provided we assumed the discontinuity of energy. (See Mr. D'Abro's, *The Evolution of Scientific Thought,* p. 381, where he caustically criticizes the philosophic method.) Mr. D'Abro says: "We must assume, therefore, that there exists atoms of action in nature just as there exists atoms of matter" (p. 382). "The verdict of scientists is that the atomicity of action entails a gigantic revolution in our understanding of nature" (p. 382). Mr. D'Abro admits, it would seem, that previous scientific understanding has been just about as erroneous as it possibly could be, and that, even yet, no intelligible theory has been proposed by the scientists. Not only this, but Mr. D'Abro and others claim that they are now left in a seeming chaos. Not scientific understanding, but utter confusion is the ending of scientific experimentation and interpretation after all these years. Mr. D'Abro cannot say much worse of the philosophers. Let me, in confirmation of this description of the scientific dilemma, quote from his pages. First the words of the great mathematician, Weyl (p. 382–3):

"No causality of physical nature which is founded on

rigorously exact laws'' is to be found in nature. And in Mr. D'Abro's words: ''In the realm of the microscopic, we appear to be confronted with total chaos and anarchy. The past does not entail the present, as it would in a purely deterministic scheme. Free will appears to be rampant; and our sole means of prevision is to establish averages. . . . Statistics and probability, blind chance and uncertainty, take the place of rigid determination. Of course it may be that a further advance in our knowledge will enable us to rediscover a deterministic scheme beneath the chaos which is now confronting us. But the point we wish to stress is that in the present state of our knowledge no definite stand can be assumed.''

Mr. D'Abro has here painted the picture as we would have depicted it. Unless the scientific mind can interpret events in terms of mechanical determinism it sees nothing but chaos. The admitted scientific chaos of today refers, the scientist thinks, only to small relationships. In this view the scientist is again in error. His averaging formulas are somewhat incorrect in all relationships. Nor has he described the large relationships of the universe, nor its reversed cycles of motion. The trouble seems to be, after all, that scientists have not relied sufficiently upon philosophy. As a result he cannot correct his errors. Certainly, empirical experience will never reveal the truth to him, for as we have already said, the organs of sensation bring knowledge only of gross averages—and this knowledge is only approximate. Therefore, unless the scientist does turn to general philosophy, he is doomed to flounder pitiably in a morass of basic misconceptions.

Mr. D'Abro says: ''There is every reason to suspect that the atomicity of action is closely related to the atomicity of matter'' (p. 383). And then he continues, since it has been discovered that the ''domains of probability'' of actions are ''now of finite extent instead of reducing to points, the possibility of space-time turning out to be atomic suggests itself strongly.'' As Weyl said, the quantum-phenomena ''are throwing their shadows over the sphere of physical knowledge [I should say misconceived knowledge, due to an in-

correct philosophy], threatening no one knows what new revolution" (p. 383). At this point Mr. D'Abro satisfyingly conforms again with my philosophic theory by remarking that it may be "that we shall have to recognize them [space and time] as approximate concepts which will have to be abandoned when the infinitely small is contemplated."

I suggest that these concepts be abandoned as principles participating in any physical event, large or small. Philosophy may pick the flaws in science, may disclose the errors in its foundational axioms, and may finally propose a correct premise, but even so, one cannot but sympathize with the trained mathematician and agree that much of the philosophic argument has been based on ignorance of fairly proved facts. Both the scientific and philosophic minds have been weak. Science has needed more philosophy, and philosophy has needed more scientific grounding. In both fields, apparently, the human intellect has merely been stumbling along. Mr. D'Abro, however, seems to be confident that science will continue to be completely scientific—that is, completely empirical. Science must always, he thinks, rely more upon specific experience than upon reasonableness unjustified by a specific experiment. He remarks: "One thing is certain: we are faced with a gigantic revolution; and the new ideas will undoubtedly conflict with the common sense instinct which the rationalist often erroneously attributes to 'reason.'" (p. 383)

Yet, to be fair to Mr. D'Abro, it should be stated that he does not belittle the philosophic point of view *per se.* He thinks, however, that the scientific method is to-day far more exact than the philosophic method, that its facts are being coordinated, and that guessing will be of little avail until the scientific method has been carried on much farther —*by scientists.* According to my view, science is now in urgent need of more philosophy. A continuation of the old scientific methodology is apt to lead to even greater confusion.

There does seem to be a chaos subsisting within a cosmos. Reason, however, tells us that there can be no chaos, hence, unless we can re-define events and establish new formulas that will apply equally to the whole and to its parts, we can

be assured that our new interpretations and definitions are inaccurate. A soundly based premise will call for a certain measure of order and purpose even in those minute energy-relationships where the senses, so far as they can judge, seem to discover only mechanical chaos. And as one step towards this understanding, and towards this re-ordering of mechanical formulas and philosophy, let us consider further the concept that there is through the time of our usual experiences an almost perfectly balanced energy-equilibrium in the gross volumes of the regions of our experiences. We wish to learn whether the gross mechanical environment can thus be described.

The status of the smallest bit of matter is exceptional—even unique. Having no parts, its internal relations cannot be changed. These particles can therefore deliver energy to their surroundings only in some relation to their own velocity of translation through space, for they have no structure maintained by the more rapid internal motions of separate parts. They have no parts to oscillate in fairly balanced cycles. They do not exert expansive pressures at their bounds in various directions which must be offset if the structure is to be maintained. They do not display elasticity. Certainly, therefore, the formula describing the unit of matter will not perfectly apply to the composite.

The mechanical reality of matter, furthermore, is made real to us, to our senses, from forces which it, as part of the whole, receives from outside itself. Hegel said: "Unconscious things can be realized, defined, and exist in a real or significant way only in relation to other external things. No one thing is a self-determining centre of being and action. It has no inner life, no power of return to itself. The significance of things physical . . . is exhausted by their external relations." Hegel thought that nature had neither kernel nor husk, neither power within nor without—but was both kernel and husk at once.

If the postulated energy-equilibrium of the averaged mechanical whole is real, however, then, when some change causes pressures to vary from place to place within this whole, adjustments must quickly follow, and soon the energy-

equilibrium will again be restored to its former average state of perfection. All the elements, moreover, are composed of similar unit parts, and each of these parts will have a consistent relationship with the other similar parts of the structure while it remains in that "cohesive" formation appropriate for receiving the external blows without disorganization. The average component parts of the land, the air, and the spaces above the air, we say, cannot for long deliver to the unit area of their average bounds less than the average of the energy of the universal pool. When an unbalanced energy-state is created, it must mean that the same energy-delivery at structural bounds does not then obtain in volumes side by side. Hence, at that time, motions in search of energy-balance—even movements that may disrupt previously balanced structures—will be in order.

We shall not consider here the nature of the cause of states of unbalance. We may be sure that whenever the particles of a composite body are moving so as to maintain the normal energy-balance at the average bounds of this structure there will then be a constant amount of energy-expression towards (as well as away from) every direction except that in which some unusual change may be taking place. We can be sure, too, that the effect of any unusual energy-change will quickly permeate the physical formations of the environment, spreading indefinitely until reversed by an "absolute" power. New motions with new velocities will then appear, and structures of new kinds will be created. The unbalanced movements will persist until balance has again been restored.

These are two sorts of unbalanced motions. Water-particles rushing into the wake of a steamer momentarily exhibit unbalanced motion in what might be called the midst of a general balance of forces. These unusual movements cease as soon as the equilibrium has been restored. Localized changes induced by a local use of unbalanced energy are soon compensated—at least in the place where the change originated. The old structural formations soon are to be seen again approximately as they were. If, however, some mechanical condition of the universe should be changed permanently there would then be a permanent alteration of the

structural formations (or energy-volumes) of all the elements. The molecules of the elements will then separate or come closer together—or else they will depart from their old fairly stabilized formations. There are temporary and permanent changes in the physical structures.

Modern science (at least that scientific group which still admits a distinction between matter and energy) has learned that the matter-particles composing all composite substances, constantly move. The unoccupied volumes between the oscillating parts of a stone are tremendously greater than the occupied. The separate corpuscles are constantly moving in those interior spaces within atomic structures, and yet are constantly being checked and returned to their original positions like the pendulums swinging from a rod. The movements (and they display the usual energy) continue unceasingly, but they are usually reversed quickly—or deflected. For this reason the bounds of structures are not extended beyond some relatively constant limit.

Now the energy of the return of the particles to the structure may be described in words as an "attraction", or as a "cohesion", but, whatever the nature or source of the energy of motion may be, reason informs us that, so long as the parent body as a whole remains motionless, all the energies expressed this way and that against the average particle composing it are balanced within the space and through the time in question.

This is the important principle: The average of all the positions of swinging pendulums supported by a rod may accurately be described as vertical; and if the supporting rod does not quiver it is thus proved that the separate energies of all these motions (and also the forces consumed in stopping and reversing the pendulums) must be symmetrically disposed about the rod. Likewise a body floating in a lake appears to remain motionless even though it is being struck from all sides, and even though its separate parts are one by one constantly moving in unbalanced fashion. Yet, since, *in the average,* the body neither contracts nor expands, we have the right to assume that through average time equal impulses strike it from every direction—and also that the pres-

sures away from and towards it, even though they are granular, are yet in constant average balance. There may be a slight quiver due to the state of unbalance during those tiny intervals between unit-blows, but this unbalanced force is so slight and ineffective that it perhaps can neither be perceived nor measured. Usually it is not even conceived.

If there were internal "attractions" or "cohesions", (that which is inconceivable) they are certainly insufficient of themselves to maintain the structure as it is, for other forces, as we know, strike in and deliver energy. And surely *all* the forces of restraint, those from within and without together, must exactly balance all of the expansive tendencies of the particles composing the structure, for, of course, their motions tend to carry these parts out of the bounds. There they must be reversed if the structure is not to be disorganized, or if it is not to expand unduly. Granting the truth of this, it follows that the more we realize the effectiveness of the restraint derived from the blows of the exterior corpuscles, the less potency shall we be inclined to attribute to internal "cohesions" or "attractions".

A stone, after all, is quite like a gas-balloon. Neither structure expands in the average, not because "cohesions" or "attractions" at a distance of its parts one for another, restrain it, but because it exists in an environment that is delivering energy to its volume. The exterior molecules pound against the balloon from outside with a force equalling the outward blow of the interior gas-particles against its cover. Except for this pounding the particles composing the gas would soon come to rest. The particles seem to derive their motions, and also their average expansive forces, from the movements of molecules surrounding them, and not from "spontaneously" created interior "thermal motions".

Indeed, we are led to think that all the permanency of every structure is obtained, not from actions at a distance of the structural parts, but from external blows. The separated parts do not "pull" one another into permanent concentration. Rather, their motions at any one time tend to continue along straight-line paths. The paths of the air-particles while moving freely do not bend around the centre

of mass of the balloon, and they do not noticeably curve between points of collision. Nor do they stay close together. This in itself seems to prove that forces at a distance do not operate between them. The particles constantly move because they are constantly being pounded from without. This renewal-supply of motion is received at the limiting border of the structure, and the limiting border is itself established and maintained by the principle which accounts for the general energy-equilibrium of the physical universe.

The particles move in straight lines through the parent-structure until a collision occurs, and in the average they encounter blows from the outside just sufficient to reverse their motions, and to maintain the parent-structure *as, in the average, it is being maintained.* The formation, hour after hour, is thus being re-composed by blows received. Thus, even by remaining inert as an average whole, it subscribes, as it must, to the principle of energy-equilibrium. We thus learn why the structures of the elements remain for long periods with one average volume and density. All structures are maintained in accord with the same principle. Permanency and average symmetry of structural formations result from uniform exterior pressures. And different structures vary in densities while facing the same exterior pressures. This is true because their atomic parts are arranged differently and therefore move with different average velocities and frequencies.

Certain velocities are appropriate for certain structural formations. Parts moving fast cannot remain permanently in a formation suitable for the retention of slower motions. The atoms composing gases, liquids, and solids are, and act, fundamentally the same. All atomic parts move back and forth in straight lines up to the points of collisions. The curvatures which are ascribed to "attraction" are due to the blows of invisible and unrealized particles flowing in unbalanced fashion towards that which is said to "attract."

This, however, is not the conventional opinion. Physicists cannot see within the atom yet they have imagined the existence there of electrons tracing elliptical paths about the centre of mass. They assume that the curvatures are caused

entirely by the electric attractions of the central mass, and they hope to explain the patterns of light-radiations on the spectrum though their assumptions as to the spacings and motions of these tiny parts. Now, regardless of what the electrons may be, the energies of the particles are found first on one and then on the other side of the centre of the mass of the atoms, and surely this fact makes it reasonable to assume that the structures of the atoms are maintained by the energy of blows received from the outside—an energy-receipt which even causes the reversed motions inside. It is this energy-delivery from without, then, that establishes the average state of equilibrium that obtains (when sufficient volume is considered during sufficient time) within every atom. This equilibrium is *maintained,* and its reality prohibits undue expansion or condensation of parts.

Now we may not perceive the tiny vibratory motions of the parts of balanced structures, but this does not disprove the reality of such motions. Nor does it contravene the fact that the mass-motions do compensate and balance one another, and thus create and re-create the structural formations which we regard as permanent through time. Indeed, the principle of energy equilibrium *within* earth-bodies (and the same energy-relation between earth-bodies and their environment) is a necessary postulate of any philosophical interpretation of the universe. Except for this cause of balanced motions there would be endless dissipation. The important question is: What is the source of the general power which generally and also locally reverses the motions? Is it either "attraction" or compulsion? Whence comes it? Is it mechanically or spiritually founded? And can it be derived (I ask you who are supposed to understand what Professor Einstein means) from space-time curved at a distance by the mere presence of unusual amounts of matter? Aristotle himself introduced an aspect of reasonableness into his explanation of curved motions in general when he argued that the heavenly bodies naturally move in a circle because this is the only motion which can continue for an indefinite time.

We have accepted for the time being the premise that

there is an energy-equilibrium in the physical environment immediately surrounding us—a repeatedly re-created energy-balance. The cause of this restraint local and general is attributed to spiritual rather than to mechanical forces. If we combine with this assumption the idea that an evolutionary change is taking place in matter which constantly disturbs the balance of mechanical pressures, we shall perhaps be well on the road to an explanation of many of our problems. Let us make use of these assumptions, then.

The atom of every complex element, as has been recently learned, is composed of hydrogen atoms (or hydrogen-nuclei); but, in accordance with the principle of energy-equilibrium, these hydrogen parts must, when averaged through time and space, remain harmoniously balanced within the various structures. All the atoms of certain elements must be like marbles of uniform size and weight, whereas the building block of all the more complex atoms, the hydrogen atom, must be of uniform mass.

The mass of the atom of the more complex elements, as science has discovered, increases in almost direct proportion to the number of hydrogen atoms composing them, but when the density of an element increases—as when steam is condensed into water—there is no change in the number of hydrogen atoms within each composite atom, but merely a change in the average distance that the structural parts move before their directions are reversed by exterior forces. Whether the parts of the body are expanded, or relatively compressed, whether comparatively quiet as in solids or boiling as in gases, we may assume that an internal and external harmony of energies exists.

When the equilibrium of an air-balloon immersed in water is being maintained by the opposed blows of the exterior water-molecules against the interior air-molecules, there can be found no place for "attractions" or "repulsions" at a distance. And the more we study every atom, even those composing the threads supporting the hanging pendulums, the surer we shall become that there is no such force in nature as a "pull" through empty space. And, except for external pressures,—that is, except for blows from the outside, and

collisions effective because the smallest bit of matter possesses inelastic solidity,—there would be constant radioactivity of the parts of every composite structure. Lacking restraint from external sources the gas-balloon would explode, and the structure of the threads supporting the pendulums would separate into unrelated parts. The particles of all composites, if external restraints were removed, would leave the parent structure; and the internal "tension" or "cohesion" which is supposed to operate through space from one particle to another so as to cause a limited concentration only, would then be seen to have no reality. There would be no bounds to the dissipation of matter if we depended only upon "attractions" to limit separations. And there would be only one solid ball of matter if the power of attraction had the reality conventionally attributed to it. The air-molecules would not now be moving, the pendulums would not now be swinging, except that they received straight-line motions from that very external energy-field which restrains them.

If this be so, the general radiation of particles from a structure can signify but one of two things—namely, either a permanent or a temporary change in the external restraining pressure. We conclude, indeed, that radioactivity is never a "spontaneous" occurrence developed within a dead mass by a type of volition, or by any self-created activity of abnormal type, but that radiation takes place when the average receipt of energy against the surface of a structure changes. When the average of the external pressure is altered, the formation of particles composing an atom may expand until some of them break away. These particles will then move past the normal limits of this structure into the freedom of some more universal formation, just as the pendulums swinging from a rod will break loose when some force reduces the so-called restraining tension of the supporting threads, or as air-molecules will burst the cover of a balloon when it is placed in vacuo.

According to this hypothesis, one might think that the element, radium, is radioactive because the general pressure from the outside is being reduced; but it is perhaps more logical to believe that such radioactivity occurs because of

a general increase of pressure. These structures which are more complex and more loosely knit are able to remain in fairly permanent organizations only in an environment of comparatively infrequent and moderate energy-receipts. When the exterior particles move with abnormal energies against any structure it tends to expand. And when the delivered energy becomes sufficiently intense, then, if the structure is sufficiently large and complex, it may tend to disintegrate. If, therefore, the average velocity of matter increases as its quantity reduces, the complexity of atomic structures should gradually lessen. According to this theory, the disintegration of atomic structures will proceed from the complex to the simple. Finally only the hydrogen atom, or something even less complex, will remain. In the final wind-up the simplest of all material structures will probably exist last.

The theory has other implications: According to it, we should assume that the velocity of light tends to increase rather than to diminish, and that there is average dissipation rather than concentration among the more complex bodies. Even gravitation, moreover, while it appears to exhibit concentrating tendencies in relationships involving the more dense structures, may, in the large, be overbalanced by general expansive tendencies. Indeed, such an unusual expansive tendency appears to be illustrated in the radioactivities of alpha, beta, and gamma particles from the atoms of many elements. Such radioactivities are now verbally described as being "spontaneous," but this description is not an explanation.

Except when a structure is radioactive there is a balanced harmony between its external and internal energy-relationships. When, however, one object (composite and therefore elastic) is moved until it strikes another unusually, this collision (in which it receives abnormal resistance to motion in this one direction) will disturb the energy-balance. Its moving parts will react farther than usual. To consider the radioactivity following these unusual contacts (short-lived illustrations of that increase of external energy-delivery which, when persisting, causes the general radioactivity from complex atomic structures), let us imagine a rod on which

a number of balanced pendulums are swinging. Let us assume that the rod itself receives a blow from a moving body and is impelled to the right. What happens?

The movement of the rod to the right will increase the tension of the threads attached to the pendulums which are at that time swinging toward the left, and will lessen the strain on those threads leading to the right. If the threads are sufficiently "strong" they can withstand the increased strain. Inelastic but amply strong threads—if there could be such inelasticity—would permit the motion of the rod to be accepted instantaneously by the pendulums. There would then be no radiations. Again if the threads were made of rubber they would stretch, and the pendulums moving to the left would accept the acceleration gradually, and again, perhaps, without radiations. The structure would expand, but its parts would not leave the formation permanently. There is, however, a third possibility: Some of the threads will break under the abnormal strain. In such case the pendulums will be released from the structure and will shoot off into space in the direction of motion at the time of release. The structure will then be "radioactive" of some of its parts. Indeed, it seems likely that unless a parent body is a perfectly inelastic solid, —one which has no parts, no connecting threads—some of the pendulums will be released by every unusual collision.

We doubt if all the threads holding the structure of atomic pendulums together will ever be sufficiently elastic and strong to retain all these moving parts permanently within the bounds of the old structure when its normal energy-equilibrium is disturbed by an unusual energy-receipt from some one direction. How can all pendulums be retained if that which is called the "tensile strength" of the restraining threads comes itself from the *usual* blows from the outside which have now become unusual. At least some expansion of structure is in order, and some of this expansion is apt to lead to radiations. If, however, any parent body were solid throughout, it must, when struck, move as a whole. Either this, or it must be decomposed and lose its quality of solidity.

Modern knowledge of the composition of the elements proves that no atom *is* solidly homogeneous. Though we may

believe it necessary to regard the smallest bit of matter as absolutely solid, we cannot ascribe rigidity, or homogeneity, or unceasing unity of structural form, to any body larger than an electron, and probably not even to it. Therefore, when two complex bodies, both containing many discrete corpuscles, collide, something has happened which should cause unusual expansion of structure in certain directions.

After the effect of every unusual collision has been completed the forces acting against, and from within, each body must soon balance. According to mechanical principles they must in the average balance in every direction. How may the new balance be gained? There appears to be more than one possibility. The parts may shift into new relationships. The shape of the structure may be changed, as in the case of a mashed piece of putty. Putty does not return to its original shape when the unusual pressure is removed. Or, the parts may shift to temporarily new relations within the structure, lasting only so long as the unusual pressure is maintained. By assuming a new shape, a struck object may be able to offset unusual pressure along one axis so long as it persists unusually. This principle is illustrated in the case of an air-balloon flattened under a weight, or by the momenta of repeatedly falling rain drops. When mashed out of round the parts of the balloon receive sufficient excess energy from the earth beneath to permit them to resist the unusual force from above. When, however, the unusual series of blows ceases, whether it be derived from gravitation or from rain drops, the balloon will return to its old form, for, when its moving parts are thus arranged in the average it will be in energy-equilibrium with the normal environment. The structure of the normally spherical balloon balances the abnormal force-conditions by yielding to them. Now, what about radioactivity when the balloon is thus mashed out of its usual spherical formation? This question chiefly concerns us.

Within certain limits, the balloon, when subjected to unusual blows along parallel lines, does not become vigorously radioactive. Up to a certain point it does not burst when a weight is placed upon it. And very little heat will be given

out in this cycle of change of the balloon from sphere to oval and back to sphere again.

Very little radiation, therefore, follows a moderate mashing of very elastic bodies like air-balloons. Nevertheless, probably all composite bodies give off *some* radiation after every change of structural relationship that is brought about by the necessity of meeting changed energy-receipts. Radiations occur at the time of the abnormal collisions, and also while the objects are reaching a new structural balance with their environment. For a time, too, after every sudden collision, the pendulums of the object, even if they do not break the restraining threads, will swing unusually far, and will display an abnormal energy of motion in a certain direction. They may thus affect the environment with that unusual energy-effect known as heat. Water always radiates heat immediately after a stone has fallen into it but the temperature of the water rises also.

Even such structures as putty or lead, which absorb unusual blows by fairly permanent shifts of parts, display expansions of atomic structural formations (the beginnings of energy-radiation) as they change their internal relationships. Perhaps no elasticity, no "cohesiveness" of structure, is so perfect but that some of the particles of a composite will be removed permanently from the old structural formation by every abnormal energy-receipt. This radioactivity, however, is temporary. Continuing radioactivity, like that of radium, does not come from an unusually severe blow felt during a moment. Nor does it derive from a principle of "spontaneity", or from volition. A continuing radioactivity is due to a more or less permanent series of *changes in the average energy-delivery* from the outside. The atomic parts of radium one by one tend first to expand and then to burst forth—just as one might expect gas-balloons to explode one after the other if placed in a large box wherein motions were becoming more and more intense.

Radiations of both of these types—one due to an unusual blow, and the other due to a change in the usual series of blows—consist normally, at least to some extent, in the permanent expulsions from the atomic structures of tiny cor-

puscles. These soon may be found moving in the diffuse spaces outside with great velocity. These particles, to begin with, and later as energies are handed on to and delivered by other particles, give unusual, and therefore unbalanced energy-effects to their environment. When these unusual energy-impulses (or waves, as we may call them) reach our bodies they permit sensations which, when mentally interpreted, we describe as radiant heat or light. Every collision of matter generates some radiant heat, some expansion of structure with an energy-delivery in a certain direction that is carried on through space by the surrounding medium until it effects the distant environment. In the average the effect reduces inversely as the square of the distance. This energy moves at that speed and in that energy-series which we call radiant heat. The principle that there are energy-radiations from unusual energy-deliveries is true of all composite relations. It fails only with regard to the collisions between the smallest and ultimate bits. These tiniest masses either deflect as wholes from one another, *or else their motions are cancelled without energy being accounted for in mechanical terms.* Nothing else is possible as we shall discover.

The principles governing the unit event are usually almost completely opposed to the principles governing the composite. This fact is illustrated here. The laws of the composite are not the laws of the particular. Yet, all man's sense-data are derived from the composite relationship. It is not remarkable, therefore, that the laws and philosophy established by science do not pertain to the fundamental reality. On the contrary, the axioms of science, because based upon rules of generalized value, are unreal as basic principles, worthless for dealing with unit events, and misleading as guides to a true philosophic interpretation of reality. The composite average with which the physicist treats, and which he formulates, has billions of times as much void in it as real matter, and the formulation of this void and real matter together naturally describe the reality of the physical matter to less than a billionth degree of accuracy. Nevertheless, a rule may have practical value for use with these composites of the usual and repeated experience if it is properly *factored.*

The mathematical physicist, however, who has little respect for the lay philosopher (and we do not blame him much), and who relies on his formulations of composite experience (and here we do blame him a great deal) as a means of arriving at basic truth, is usually too satisfied with his axioms, methods, and laws. He is thus deceived in his opinion of reality. The scientific methodology, as we shall learn later, is at fault.

There is no doubt about the movements of particles in the empty spaces within the usual composite body. Only the smallest bit of matter is solid, inelastic, and without internal motions of parts. As Professor Karl Pearson said some years before we had our present knowledge of the structures of atoms:

> If the parts of a body move closer together, they must have something free of body into which they can move. If a body were continuous and yet compressible, there appears to be no reason why it should not be indefinitely extensible, both results repugnant to our experience. Thus it is with that relative motion of the parts of bodies upon which so much of modern physics depends; absolutely close packing, that is continuity, seems to render it impossible.[1]

If this statement be true, then all composite bodies are more or less yielding, for they are all discontinuous, and all have open spaces between their parts. And when such bodies collide, the collision—and the consequent changes of equilibrium—will surely alter (either permanently or temporarily) the relationships of the parts. Indeed, this change of relationship, if sufficiently prolonged while still uncompensated, should cause the ejection of at least some of the solid particles from the parent organization. The alternative is the possession of a perfect structural elasticity, as it is called, for a certain range of movement, like that of a theoretically perfect gas-balloon in which a new equilibrium of pressures with the outside is obtained by a general change in the shape of the structure. The question is: does such a structural change

[1] Karl Pearson: *The Grammar of Science* p. 209.

induce energy-radiations? For a structure to possess perfect elasticity, for it to have perfect ability to attain under heavier pressure a new contour as harmonious with the energies of the environment as the old, and for it to be able to accept mashing distortion and a new structure while all parts are retained within the normal structural bounds, the separate particles comprising the composite body must, one would think, be perfectly elastic themselves. That is to say, these small parts must lack all rigidity, solidity, inertia, and permanency of their own structure. Such a presumption, however, is contrary to our definition of the unit of matter. One cannot understand how a grouping might be composed of the rigid granular bits of our definition and yet be so perfectly elastic as a structural whole that it will lose none of its parts during an unusual period of pressure from one direction.

If, however, the smallest bit of matter *is* rigidly inelastic, if it jealously holds to a certain amount of space-volume, then the entire volume of any structure containing it *is not completely elastic.* Perfect average elasticity of composite structure is inconceivable. This itself is sufficient to destroy belief in the theory that the molecules of a gas repeatedly rebound from each other without loss or use of energy—merely because perfectly elastic. How can molecules be perfectly elastic if composed of atoms of the usual fairly inelastic variety, and if the smaller particles are completely inelastic? The theory of molecular action is entirely incompatible, too, with our definition of elasticity. It appears that no composite is completely elastic, and that probably none, therefore, can yield to a force without some tendency to an expansion that is apt to end in radiation of parts.

We believe that many energy-radiations begin as emissions of mass which are not returned so long as the unusual energy-situation obtains. Perhaps some expulsions of parts should be expected from every unusual distortion of the structure of a balanced composite body. The distortion certainly destroys the structural balance, and it calls, too, for some change of average distance between the parts. After any unusual condition of external pressure we should therefore expect to find some of the pendulums detached from the

rod. Threads will be broken which formerly held them swinging; and some of these tiny bits will now be discovered flying away from the parent body into the open spaces. Either excessive motion or failure to receive the usual motion from the striking body, may cause breakage of the threads and disruption of structure; and this radiation, once started, will continue until a new equilibrium of structure and of energy is established by new adjustment of internal and external forces.

In other cases the particles inducing the unusual radiations of energy will not leave the parent structure permanently, but will merely reach a position farther than normal from the centre of the structure. The threads holding them will stretch unusually, so to speak, because these particles are then moved with unusual energy in this direction. If their unusual energies are entirely delivered to the surrounding fluid before the threads break, they will be returned normally to the parent-structure when the unusual energy-delivery ceases, otherwise not.

In later pages we shall attempt further to prove that light-and-heat-radiations consist—to begin with—of the expansions of the normal structures, and often in the emissions of masses. Either the smallest particles may radiate one by one, or the smallest bits may radiate in structural formations of which the separate bits are themselves fairly permanent parts. The smallest bullets may be shot from an air-rifle one at a time, or they may be fired many at a time as a composite projectile from a shot gun. Every energy-emission, however, whether large or small, takes place, we believe, because the principle of universal equilibrium requires that the structural organization shall (in the average of time and space) remain balanced with the average energy-delivery that it receives. When unusual contacts occur, when structures are too much distorted by unusual blows from one direction, the new energy-equilibrium is usually established most easily by the permanent rearrangement of the structure, and this often makes necessary an emission of material parts. [1]

[1] There is a mechanical theorem that if two inelastic bodies collide head-on when moving in opposite directions, all the kinetic energies of motion are to

Let us now refer again to the classical theory. When elastic bodies collide heat-radiations occur which are supposed to pass through empty space as undulations of an imponderable ether. Waves of energy are supposed to occur in a medium without parts possessing mass or inertia. Matter is not supposed to be emitted to account for radiant heat-energy. It is not normally believed that this energy is delivered as the blows(first immediate and then transferred) of inert corpuscles. And yet heat from the sun delivers energy to the earth, and if the energy is transmitted by an imponderable medium we must suppose that this medium itself has the ability to display energy. But how can energy be delivered by a wave-motion in any medium unless the force of the wave is finally received as the momentum of inert space-consuming matter? The ether of the conventional theory, moreover, is a sort of matter outside our definition.

Physicists have tried recently to escape the difficulties of the ether-concept by resorting to a theory of electromagnetic waves of energy in a "field" still supposedly imponderable. They try to disregard the properties of the medium itself, and they do not describe the actual delivery of the energy. Yet, as has been already said, either the electromagnetic theory is virtually an admission that the matter-particles form the "field" through which the motion passes from the sun to earth to give us heat-and-light-energy, or else the explanation is merely a word-description as inconceivable as the ether-concept. An electromagnetic wave cannot be pictured as a bearer of energy unless the moving wave is itself composed of matter-particles possessing conventional mass. The electromagnetic volume or "field" containing lines (or waves) of force, if it is worth considering as a medium for the transfer of energy, must signify the presence of the unbalanced motions (direct or transferred) of inert corpuscles.

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be accounted for either in heat-radiations or in shifts of parts. I have already intimated that I hope to prove this theory incorrect. My proof does not refer to the principles of discontinuity and universal energy-equilibrum as set forth above, so that the independent demonstration supports the theory that radiations cannot occur when the smallest corpuscles collide. If the radiations *cannot* occur when *real* solids collide, a long step has been made towards proving that heat-and-light-radiations result from emissions of the smallest bits of matter singly or in groups. In fact, there seems to be no other possible explanation.

Nor can we conceive how an imponderable electromagnetic wave might induce thermal motions in a gas.

The realm between the worlds, we believe, is a structure composed of material parts. It is therefore much like the structure of an atom of iron, except that the parts are more diffuse, and move with greater velocity. The greater swiftness of movement of the particles in the spaces between worlds is required to compensate (in terms of energy-delivery) the greater diffuseness. In this structure of the open spaces (or "field" of matter exterior to the atoms of the elements, as we may call it) the corpuscles must move to and fro invisibly and rapidly. They may strike each other within comparatively short distances, or they may pass through greater distances as unresisted projectiles with mass and momentum. These corpuscles occupying the volume between sun and earth, by acting and reacting upon one another, must be able to transmit momentum so effectively (except for the natural diffusion), and with so little uninterruption that a certain definite part of the original energy of the radiation of mass from the sun will finally be delivered to the earth by the movement of the last particle in the train—just as air-molecules transmit, through a series of collisions one with another, the series of motions which finally, through the blows of the nearest molecules, reaches us as sound. And that which we call the "elasticity" of the fluid medium as a whole is the principle that maintains the almost uniform velocity of this translation of unbalanced force. We do not believe it necessary to confuse ourselves with the idea that energy might be delivered by the contact of a non-material essence like ether, or even that there might be such an imponderable fluid. Planetary motions must be explained in terms of the hypothesis that a material fluid fills inter-world space. We advance such an explanation in later pages.

The blow of light, we claim, cannot be delivered by a "field" of force as distinguished from a field of bodies having inertia. Nor can the motions of the solid particles composing a structure be constantly reversed by any powers contained within its boundaries, nor contained within any other motionless solids that it may strike. Internal oscillations

evidently pertain only to the aggregations of the small particles composing a structure. In structures of limited volume the parts are driven through exterior contacts first one way and then another through fairly short distances, and with comparatively slow velocities. This is the condition of all the elements composing our earth-structure. The theory of light-radiations from such structures is considered at some length in Chapter XXIX. Here let us consider heat-radiations.

The word "hot' 'is nominally used by scientists to describe the condition of a body by virtue of which energy-radiations from it (or contacts with it) gives us heat-sensations. Our knowledge of heat comes from experience. We can detect its presence but we know little of its nature. Radiant heat always appears from a body under certain conditions—and that is about all the physicists can say of it. It appears, first, after a collision between bodies which have certain internal conditions,—conditions which are to be found in every composite body,—and secondly, it is produced by radium with seeming "spontaneity."

If a stone falls into a pond, part of its energy of motion is converted into the "heat-energy" of the water, as it is called. The heat-energy represents a fairly uniform percentage of the energy of motion of the stone which is stopped by the water. The water-molecules supported by the upward forces of the earth underneath them, do not move freely before the stone. At first they are unusually compressed by its blow. The energy of motion of the water-molecules, furthermore, is increased by the force of this unusual blow from the outside. Later the molecules react from one another and from the earth as from stiff springs. In this rebound many of the molecules (in time) break away from the formations known as water-molecules and radiate into space, just as the pendulums attached to the rod leave this structure when the threads are broken by which they are suspended. Meanwhile the temperature of the water rises. The unusual reflex energies of these tiny particles of matter emanating from the water with unusual energies of motion in a certain direction (the direction of the usual blow, or its reflex,

either in straight lines, that is, or as spread by diffusion through the composite structure) are capable of delivering unbalanced energy to the surrounding material medium (itself a composite structure), and when these energies are delivered appreciably to a permanent structure like one of our elements, and increase its internal motions temporarily, the effect is known as the delivery of radiant heat.

While the unusual movements of the water-molecules after receiving the impact of a falling stone account for all its rise in temperature, one should not assume that all of the unbalanced energy of the stone is converted into that phenomenon known as heat. It is obvious, for example, that the position of the earth in the solar system is changed by every such blow, and this cannot be described as an example of heat-energy. Also waves in the water are created by some of the energy of the falling stone. As these undulations are approximately self-compensating, it might appear to some that they express no energy. Nevertheless, energy is required to originate the first wave-movement, and also to reverse the rising and falling of the water—and this is not a manifestation of the phenomenon of heat. Energy is delivered, too, by the waves when they strike the shore. Yet it is true that a certain percentage of the energy of the falling stone is stored temporarily in the water in the form of increased movements of the water-particles. These abnormal "thermal" motions deliver the heat-effect to their environment. A mechanical equivalent has been experimentally derived for this temporarily retained heat-energy. The amount of stored heat (before the gradual radiations to the environment of these unusual internal energies of motion take place) varies in almost a constant proportion of the energy of the falling body. This fact simplifies the formulation of this so-called "mechanical equivalent"—which is not really an equivalent.

About 1845, an investigator by the name of Joule (1818–1889), found that one British thermal unit equals approximately 772.4 foot-pounds of mechanical energy. The experiments carried on by Joule involved falling weights, which, by descending, revolved paddles immersed in water. The churning of the water absorbed the energy of the weight and

raised the temperature of the water. Other experiments to determine the rate of exchange between mechanical energy and heat-energy were later carried on by Professor Rowland of Baltimore with steam-engines. In 1883, Griffiths made tests by heating water with electric coils. Schuster and Gannon first, and then Callendar and Barnes, changed the electrical method slightly and obtained almost identical results. The present-day figure gives approximately 778 foot-pounds of energy as the equivalent of one British thermal unit.

In determining the "mechanical equivalent of heat", some experiments were made with gases, and these are especially interesting in that they seem to deny the reality of those attractions between the bits of matter that scientists have regarded as the basis of "cohesive" phenomena. In fact, this lack of "cohesion" was indicated by the very early tests of J. R. Mayer, of Heilbronn, in 1842. His experiments involved the determination of the specific heats of gas at constant pressure. Gas was permitted to do work in expanding, while the pressure per square inch was held at a constant. The changes in the total heat of the gas were then computed in terms of the external mechanical work. Heat and work were thus related, and it appeared that when a gas was heated and expanded, and did work in expanding, no energy was consumed in overcoming the imagined cohesive attractions between the gas-particles. All the energy appeared to be accounted for in the external work, hence the presence of restraining "attractions" between the gas-molecules seemed to be disproved. As Professor B. C. McEwen says:

> The magnitude of the cohesive forces in a gas at the ordinary density is so small that the accuracy of the calculations of the mechanical equivalent of heat from the external work done by the gas during expansion at atmospheric pressure is not sensibly affected. [1]

This statement does not refer with absolute accuracy to every condition. Later experiments of Joule and Lord Kelvin indicated that a slight amount of internal work was done when some gases expanded—and particularly when the ex-

[1] B. C. McEwen: *The Properties of Matter*, p. 3.

pansion took place in a gas compressed to great density. This internal work might be accounted for, of course, as the work done in changing the structural arrangement. The scientists have assumed, without positive proof, that the energy consumed internally in certain cases, is required for separating "cohesive" molecules. There is no definite proof, however, that energy is ever consumed in overcoming the imagined internal attractions of particles one for another. And even in those experiments where evidently some energy, for some unknown reason, is required to produce expansion, the amount of energy devoted to internal phenomena is a minute percentage of that used in doing external work. Professor McEwen asserts, moreover, that "it has been shown in recent years that there is for most, if not all, gases also *minimum* temperature at which cooling is produced by expansion."[1]

We cannot assert that any mechanical energy (as evidenced by consumption of heat-energy) is used in overcoming internal cohesions. The evidence seems almost conclusive, indeed, that there are no internal cohesions.

Let us consider once more the mashed air-balloon supporting a weight. The balloon does external work when it resists and compensates the downward force of the weight hour after hour, as any one will realize who tries to support a weight on the outstretched hand. Even if the balloon and the weight do not move perceptibly, their parts are nevertheless moving and are being moved. The parts, therefore, are doing real work, but since the energy-delivery may be regarded as first plus and then minus, and since it is balanced through time, there is no final accomplishment measurable as unbalanced motion. While we realize, therefore, that the separated air-molecules of the balloon repeatedly do work through minute distances, we have no reason to suppose that work is being done in overcoming the internal cohesions of the separated molecules. In fact, when the source of the power used in reversing the molecules is identified it will be seen that the theory of internal cohesion is superfluous.

Physicists have assumed that air-particles in a balloon move freely past one another. Certainly no two particles

[1] *Ibid.*, p. 308.

tend to cohere. They do not tend to concentrate even when they strike one another. Even when touching they give no evidence of attracting or repelling. They deflect like rigid solids. The forces of attraction and repulsion seem to be lacking entirely at the times when, if actual, they should be most in evidence. And yet, if there is no "cohesion" between the typical atoms of these gases, why should there be cohesion anywhere? Are not the particles of all the gases the same hydrogen atoms that compose lead, iron, and copper, and should not these hydrogen atoms act according to one law, wherever they happen to be?

According to Professor McEwen, the atoms of hydrogen gas (the building block of all the elements) gives no evidence of cohesive properties. He says definitely that "a perfect gas exhibits no cohesion." And he defines a "perfect" gas as one composed of

> . . . an enormous number of identical spherical molecules, negligibly small compared with their distance apart —perfectly smooth and elastic, and moving with extreme rapidity. The collisions of these molecules instantly change their velocities and directions of motions, the time occupied by such collisions thus being infinitely small. [1]

Professor McEwen suggests, too, as the reader will note, that the typical matter-particle delivers and receives motion without consumption of appreciable time. This corresponds with the theory elsewhere set forth: but we are particularly interested in the fact that with regard to perfect gases the assumption that there is cohesive attraction of parts seems to be unreal.

In thermodynamics the movement of gas-molecules is regarded as a self-contained process of reversed motions in which there is no final consumption of real energy—as energy is artifically defined. This makes it necessary to assume that the particles composing gases are perfectly elastic. This concept, however, is incredible, for these particles normally manifest no such elasticity. In fact, we have

[1] *Ibid.*, p. 15.

reached the opposite conclusion—namely, that the unit-piece of matter must be rigid and inelastic. Elasticity, as we have proved in Chapter VIII, is a quality that pertains *only to a composite,* and only to such groupings when subjected to exterior forces that maintain the group-formation. For this reason elasticity cannot be an attribute of the smallest bit of matter. What, then, is the explanation?

The eminent English scientist, Sir James Jeans, is satisfied to offer the following explanation of the thermal motions of the molecules of gases:

> We may now try to picture a collision between two molecule-bullets in a gas. Lead bullets colliding on a battlefield would probably change most of their energy of motion into heat-energy; they would become hotter, or perchance even melt. But how can the molecule-bullets transform their energy of motion into heat-energy? For them heat and energy of motion are not two different forms of energy, they are one and the same thing; their heat is their energy of motion. The total energy must be conserved, and there is no new disguise that it can assume. So it comes about that when two molecule-bullets collide the most that can happen is that they may exchange a certain amount of energy of motion.[1]

Isn't this rather a remarkable explanation? Yet Sir James seems to regard some such explanation as necessary, for does he not say that total energy must be conserved? Virtually he asserts that, regardless of the possible inconceivability of the explanation, the doctrine of Conservation must be regarded as maintained even in the so-called thermal motions of the molecules of gases. Nevertheless, in other relations these molecules display very definite energy of the usual type. They even hold the cover of the balloon taut with their poundings, and support the weight of the mashed balloon hour after hour. Therefore they display heat-energy—and energy of motion as well. He goes on with his explanation, however, thus:

[1] Sir James Jeans: *The Universe Around us,* p. 96.

> It is the same at every collision; energy can neither be lost nor transformed, and so the bullets on the molecular battlefield go on flying forever, happily hitting only one another, and doing no harm to one another when they hit. Their energies of motion go up and down, down and up, according as they make lucky hits or the reverse, but the most they have to fear are fluctuations and never total loss of motion; their motion is perpetual.[1]

Sir James seems to indicate that there is no such unit-phenomenon as heat-energy, for all elements are composed of molecules, so every contact between elements is a contact between molecules, and no heat-energy comes from such contacts. Yet this cannot be so, for when lead bullets collide, heat-energy *is* given off. And perhaps, too, the impact of a gas stream can make a body hot. And also, we observe that the molecules themselves are composed of electrons which apparently do give off heat-and-light-radiations of energy when they collide with the molecules of water-vapour, as Sir James so clearly demonstrates on page 110 of the same book. The composite, however, cannot strike unless its parts strike. Hence we cannot understand how the collision of the whole can fail to give off heat-energy when the collision of its typical parts do so.

The cause of unceasing activity of gas-molecules, therefore, is virtually an unexplained mystery in present-day physics. Even the unreal concept of a perfect and self-contained elasticity in each particle does not help us to identify the source of the energy that reverses the straight-line motions of the molecules containing the particles.

The formula that sets forth the heat-equivalent of energy has practical value, but it tells us nothing of the nature of heat. We learn from it only that certain energy-causes have certain percentages of themselves represented later in heat-effects. This is true because the bodies on our earth consist of matter-particles, which, through an appreciable period of time, maintain an almost perfect equilibrium of internal and external energies. Because large composite

[1] *Ibid.*, pp. 96–7.

formations of such a universe exhibit fairly consistent phenomena we may draw conclusions from one experience which are almost perfectly valid for another of similar kind. A certain amount of heat-energy may thus be expected to flow from the collision of certain types of bodies. These radiations invariably occur because this is the quickest way of restoring the internal energy-equilibria of those bodies unbalanced by the collisions.

We shall now dismiss this subject of radiations, postponing further discussion of it for later chapters in which the theory of the structure of the atom is given in more detail, and in which the theories of light-radiations are described more fully. Here I have wished principally to introduce the idea first, that an evolutionary change is constantly upsetting the universal energy-balance, and secondly, that this disturbance of the mechanical harmony is the cause of the radioactivity of elements which is usually described as "spontaneous." I also wanted to give additional reasons for believing that the unit-transfers of energy do not consume appreciable time. The different parts of a general theory must harmonize, hence I prefer to associate them rather than treat them separately. It might be well, however, to make these thoughts clearer by considering a few examples which illustrate the principle—namely, that within an energy-pool such as we have postulated, a formula which treats of, and averages through relatively wide-spread space and time, the effects of an enormous number of unit-events, is quite capable of giving *fairly* correct answers even though it does not apply to the unit event, and even though it is a misleading guide to a philosophical interpretation.

It is approximately correct to say that the average position of a moving swing is perpendicular even though we know that it is perpendicular only for an infinitesimal portion of its arc. Indeed, as a dictum about the expected position of the swing for any one particular time this statement is worthless, for there is not one chance in billions that it will be found in a vertical position at any selected instant. The general correctness of the statement comes, then, not from any principle relating to an expected position of the swing

at the moment chosen, but rather from the averaging of an immense number of mathematically symmetrical motions about a common centre of motion. Again, the ocean-liner may oscillate unceasingly up and down with the waves, but the designer can plot the red line of the average water-mark with assurance by merely applying the principle of averages to these conditions which are mathematically symmetrical and balanced. Except for this balance and symmetry the formulas would lack practical value. If the pendulum or the steamer oscillated each time in an entirely different orbit the averaging formula could not be used. We would then be obliged to interpret the particular event itself.

Each couple dancing in a ballroom may be moving at random, merely trying to avoid the couples alongside, but when one regards the room as a whole it will be found that the average arrangement of couples is fairly ordered,—a cosmos, rather than a chaos of individuals,—and the centre of mass of the whole can be charted with relative certainty that it will be approximately accurate. The general energy-equilibrium throughout space, therefore, gives our mechanics much of its practical dependableness as we use its averaging formulations in reference to relatively gross spaces.

To be reliable in every case, however, a formula should summarize single activities—and not merely average them. Someone may say: "Yes; but in cases where unquestionably there is no lack of mechanical symmetry from end to end of the conditions being considered the averaging formulas as developed by the physicists are sufficiently perfect. Nothing better is required." There is no such universal practicability, however, for there is no such perfection of mechanical symmetry in conditions which are limited, reversed, or undergoing change, and all of our observations and experiences fall into one or another of these classes.

Let me explain this statement: There are edges to every separate corpuscle and to every aggregation of corpuscles. There is a nothingness on one side only of the edge of every structure which destroys that perfect uniformity of condition with reference to all its parts which the averaging formula depends upon for its accuracy. Even the average uni-

formity within the very largest composite structure does not extend indefinitely. The ocean finally reaches the shore. There is also an unbalanced edge to all reversed motions, and, sooner or later, all motions *are* reversed. The edge of the lake is a boiling cascade; at the edge of life there is death. These margins between matter and non-matter, between placidity and activity, have an important bearing upon the formulas that can accurately describe them. The averaging formula cannot possibly be exact unless knowledge of the edges of the particulars is gained and incorporated in the formula. This principle may be illustrated by reference to an attempt to formulate accurately (through the interpretation of the specific experience alone) the rate of energy-delivery of ten balls following one another into contact with a wall.

Let us assume in advance that the unproved interval between their contacts is one second. How, now, can we determine this interval by making use of a formula which purports to average the number of time-intervals into the total force-delivery? Suppose, for example, that there is no watch capable of measuring such a small time-interval as a second—that our most delicate instrument records a minimum of five seconds. We then have no experimental means of approximating the unit event (the particular), here the interval between the separate blows, unless we may divide the total elapsed time by the number of blows. Even this, however, will give a somewhat incorrect answer. Why is this?

Before the first ball strikes the wall there is an edge of time, so to speak, in which there is no energy-delivery; and the instant following the contact of the last of the ten balls there is again an edge of time in which there is no energy-expression. For this reason, although the ten balls strike one every second, nevertheless, after they have commenced striking the ten blows are received in nine seconds, and the average interval of blows, as calculated from averaging the events into the time, will be determined incorrectly as nine-tenths of a second. And we cannot identify exactly the beginning and ending edges of the nine seconds of time.

These edges pertain to all composites. The averaging

formula thus give an untrue result, and the inaccuracy develops because we have tried to average conditions which contain unbalanced edges, and because we have not exactly determined the nature of the last particular containing the edge that must be formulated. We have grossly, crudely, inaccurately, included in our formula the unbalanced margins where non-events meet with events, and where no such method of averaging is possible. This inaccuracy permeates the formulations of physics.

If the calculation were made of a billion balls instead of ten, the result obtained by the averaging formula would perhaps miss accuracy by not more than one-billionth. Yet, unless there were an infinitely continuing series of blows —a process both unceasing and changeless through time —there would always be an inappreciable beginning and ending of the collisions and of the interval—that is to say, there would always be unbalanced edges in space and time which could not be made to give the average of the true time-interval between the uniformly spaced collisions. To have such an infinite series of blows, however, for more correct averaging, matter, time, and energy must all be infinite and unceasing.

Factored averaging formulas, although they are useful for gross calculations, and approximately correct as regards immense composites with approximately balanced internal conditions, do not disclose the unit-principle. Nor does the approximate accuracy of the formulas for general practices with such composites in any way indicate (as science often postulates) that there are no "absolute" changes in general mechanical relationships. Because, in many cases, our generalized working-rules (their limitations usually unrealized) have been unwisely used to interpret situations in which the unit-event (to which the formulation does not apply) is the decisive influence, certain erroneous concepts have been established as if experimentally proved, and certain new types of energy and of matter have even been invented—those types, naturally, to which the generalized formulas would be fairly applicable. These inventions, however, are philosophically unreal and unreasonable, and many of them have lately been

proved erroneous. The formulas based upon them have failed when confronted with the particular event. As an illustration, the formula for kinetic energy has failed when used with regard to the electron moving at the speed of light. Perhaps the most important error has been that which consists of positing changelessness in the amount of mechanical energy in a universe which challenges mental interpretation principally because it is undergoing continuing change. After such a fallacious premise has been adopted, hardly anything worth while can be accomplished either in philosophy or mechanics. Conformity with mechanical axioms buries us ever deeper in error. This is our present situation in science and in philosophy, and even religion feels the effect of these almost universal opinions.

We see, therefore, that we must revise both our formulas and our opinions. As we consider these subjects one idea almost automatically suggests another, and one conviction seems to tend to support another. Let us hope that finally the thought-structure will be braced by facts, proved not by gross experiences, but by reason divulging the nature of the particular. Let us so tightly cement this structure with the mortar of reasonableness that we can leave it to stand alone without fear that the first breath of criticism, or the first battering of unfriendly hands, will bring it tumbling down.

Our ideas of Time and Space are now fairly supported. We are beginning to learn, too, why the practical working formulas of physics that connect time and space with energy-deliveries have no formidable implications that might bear heavily against our theory-structure. The general inaccuracy of physical formulas will be treated at greater length in the chapters devoted to Mathematics and Mechanics. The present chapter may well conclude with Amiel's words: "Materialism coarsens and petrifies everything: makes everything vulgar, and every truth false."

CHAPTER XII

A CONSOLIDATION OF BELIEFS—AND COMPARISON

The religious man values what he sees, chiefly as an imperfect shadowing of what he is capable of seeing.

WORDSWORTH.

THIS chapter will attempt to summarize the conceptions thus far attained, and to compare them with other views.

The universe, we say, is dualistic in its arrangement, monistic in its essence, and is undergoing a process which finally make it monistic in arrangement also. The prime essence, composing even matter, is a mental power, or spirit, or will—as we may be pleased to term it. The activities within this dualism of arrangements, followed by the changes in the relationships of the two, make existence phenomenal. The subjective mental part exhibits free activity, motion-giving, and purpose; the objective material part displays inertness, occupies space and lacks appreciable will or purpose. Matter has no apparent volition with which it may manifest appreciable independent movement, or create movement outside of itself. No mechanical forces operate at a distance: Matter is responsive only to mental direction, and to physical contacts: The composition of matter is granular, hence physical experiences, though they occur instantaneously, are separated by time-intervals, and the material changes reach consciousness intermittently. From the mental viewpoint those changes relating to the groupings of matter may be regarded as secondary, whereas the phenomena introduced by the disruptions of matter, and by the phenomenal rearrangement of its essence, are of primary importance.

Life consists of perceptions of the events brought about by the Purpose behind Evolution, and of appreciations of the contingencies arising therefrom. In our earthly lives

we are concerned chiefly with the many purely secondary (or physical) changes within the body, changes which for the most part represent disturbances of mechanical equilibria. These would not occur except that Evolution alters and transforms parts of the physical foundations. We are very much aware of these physical disturbances (in gross), and of the processes involved in perfecting new mechanical equilibria. Thus we sense the roar of Niagara, the powerful stroke of the engine, the collapse of the building into dust —these secondary occurrences lying quite within mechanics so far as we observe them—but the "absolute" Change which is the negative Cause, takes place so invisibly, and the mental Cause of this Change operates at such distant bounds and expresses itself to us through such long chains of purely mechanical events, that, usually, both the Change and its Cause escape our attention.

Nevertheless, the carrying-on of Evolution is disclosed in, and measured by, the permanent and uncompensated changes. A universal mind-power, we believe, purposefully creates, plans, and directs the general motions and collisions of particles in order that certain contacts shall end in a significant accomplishment—namely, the re-arrangement of matter into non-material forms. Often, however, the motions immediately in our environment display purely physical and mechanical changes, such as the rise of a wave to a breeze, or the rush of the tides, or the cooling-off of the earth, or the decomposition of radium into a less complicated structure—this last a phenomenon which the old positivist physicist asserted was impossible.

Scientists observe, judge closely, and measure carefully the mechanical perfection of the wave-motions in so far as this perfection exists within the heart of the near-by volumes of the energy-pool, but they have failed to discern the original cause of the "absolute" reversals of motions (molecular and otherwise), and they have failed also to measure the concealed and uncompensated change in the physical being of a matter-particle here and there which makes one wave-motion differ slightly from its successor. The matter-particles, in gross, continue to move, but only because they *are*

moved; yet, because the usual motions within the physical pool-volume fall within a system, and occur with regularity and dependableness (almost, indeed, as if the reactions were caused by the actions, so similar they are), the scientists, immersed in the material medium, and failing to perceive the creation of "absolute" motion at the bounds, and the accomplishment in physical change, insist that there is no creation of motion and no decrease in the amount of substance. They do not describe the bounds, and they invent inconceivable forms of force in an endeavour to describe the interior on a basis of pure mechanism. Let us now quote some of the conflicting views principally of the nineteenth century.

That eminent scientist, John Tyndall, believed that matter controls mind rather than the reverse. The German writer, Ludwig Büchner, thought that matter was not dead nor lifeless, but that substance was full of thought and sensibility, and even of motion. He said this although he had never seen matter move of itself, and although he hardly could have believed that a piece of iron has thought, volition, or will. He thought that matter was infinitely extended in space, and, as he said, "independent of the limitations of space and time."

The German scientist, Rükert, went so far as to affirm dogmatically that "the world has neither beginning nor end," meaning by this the world of matter. He would have said the same thing of a piece of uranium. The English scientist, Grove, said that of "absolute rest Nature gives us no evidence." He believed also that the condition of matter is primarily a mode of action, although he, too, would probably have admitted that he had never seen matter start to move save when in strain or stress from forces outside of itself. Büchner states emphatically "that no kind of motion can originate or disappear, and that motion must therefore be regarded as the primal condition, or in some measure as the soul of matter."

The famous German, Haeckel, was a monist also, but his monistic doctrine, unlike that of most physicists, was founded, not on the concept of an inert substance, but on a substance

defined as in part possessing non-material attributes. He admitted the reality of spirit, but it was still substance, a sort of psycho-physical phenomenon, and rather like the spirit described by Professor Dewey.

> Pure Monism is identical neither with the theoretical materialism that denies the existence of spirit, and dissolves the world into a heap of dead atoms; nor with the theoretical spiritualism which rejects the notion of matter, and considers the world to be a specially arranged group of "energies," or immaterial natural forces. [1]

Haeckel held with Goethe that "matter cannot be operative without spirit, nor spirit without matter." At the ripe age of sixty-six, when he wrote *The Riddle of the Universe,* he believed in the monism of Spinoza: namely, that "Matter, or infinitely extended substance, and spirit (or energy), or sensitive and thinking substance, are the two fundamental attributes, or principal properties of the all-embracing divine essence of the world, the universal substance." If we attribute to part of the "universal substance" the spiritual endowment of purposed motion and its accomplishment, there will be little difference between our view and that of Spinoza.

Haeckel's definition of "spirit" seems incomplete. At one moment "spirit" is defined as an independent power and source of energy, the real mover of matter; but at the next moment it has only a physical character. This inconsistency had to be, for Haeckel, like most every other physicist, believed in the Conservation of both matter and force. Relying upon this materialistic unchangeableness, he denied that Spirit had any power or plan external or superior to matter. Spirit, he thought, is merely a certain material combination—nothing in itself. The activities of spirit exhibit only the expected physical reflexes—such as the back-swing of a pendulum—somehow balanced by motions.

Haeckel believed that the soul is a natural phenomenon and that psychology is a branch of natural science. He denied—as we have done also—that the soul and body are

[1] Ernst Haeckel: *The Riddle of the Universe,* (English translation) p. 20.

distinct entities, but he failed to point out that there is a duality of characteristic arrangements. Yet, the interrelations and changes of quantities of these two typical arrangements alone permit significant changes to occur in the physical universe. Peering solely at the mechanical facts, at these waves which have not appreciably changed, and observing from the inside of the balanced volume, seeing, that is, as a fish sees the rhythmic undulations of the seaweed, many of the scientific investigators have not glimpsed the true causal relationship of mind-power with all mechanical phenomenon. Thus, Haeckel declared that:—

> This hypothetical "spirit" world which is supposed to be entirely independent of the material universe, and on the assumption of which the whole artificial structure of the dualistic system is based, is purely a product of poetic imagination. [1]

We can accept Haeckel's materialism in so far as it refers to many events of the physical world. We can admit also that most of the relations of the mind with the body—all, indeed, that the physicist is likely to discover with his microscope or telescope—act in the routine way (but not in the mechanically necessary direction) of materialistic reflexes, *i.e.,* for the restoration of the physical equilibrium, not of matter in general, but of a particular organism in a particular fashion. We admit, too, that we know hardly anything about the spirit except as it uses matter for its instrument. Our consciousness comes chiefly from the movements of matter, and chiefly refers to them. The mechanism of the outside world seems almost perfect in those aspects that come to our attention, and especially is this true if we do not attempt to give reasonable explanations of the source of power of the unceasing reversals of motion. Likewise, the balanced cycle of the swinging pendulum seems to be an example of perfect Conservation, but this is so only to him who forgets the exterior Cause that, near or far, supplies the beginning of the power which first retards and then changes the directions of the oscillations.

[1] *Ibid.,* p. 90.

We blindly accept the presence of that which causes the restrictions and changing motions within the energy-pool. We think chiefly of the average effect of what goes on—not of that which conditions this particular type of environment. Nor do we measure the lack of perfect balance. Indeed, we seem fairly satisfied with the fact that the forces within the energy-pool follow systematic laws so closely that they may be formulated and fairly relied upon. Our minds appreciate chiefly what seems to the narrow view a mechanical perfection of give-and-take, but this should not interfere with the concept that there is a moving-power external to matter, that there is a purposeful planning Force in the universe which has its way with substance, and that this, a constantly active mental Force, causes the pendulum of the universe to oscillate. This oscillation, with its lack of perfect balance, proves that a purposeful Power is actively participating, and that a transformation of matter is going on.

The materialists have denied free power to mind in its relations with external substance; and, they have taken this stand because, as Haeckel said, they have realized that in "The dogma of 'free will,' another essential element of the dualistic psychology, is similarly irreconcilable with the universal law of substance."

"Life", said Virchow, "is only a particular kind of mechanics"; and another German scientist, Spiller, remarked that "conscious human mathematical reasoning is none other in essence than unconscious physical thought." And Büchner said in his turn: "*Thinking* and *extension* are therefore only to be regarded as two sides of phenomenal manifestations of one and the same existence." With this definition of thought as a mechanical reflex, how could there be free-will? So Büchner asserts that "None but a superficial and ignorant contemplation of man and of human existence, superadded to spiritualistic prejudices, could ever induce the idea that the actions either of an individual or of nations are the outcome and expression of a perfectly free and self-conscious will." Even Spinoza believed that "The human freedom, of which all boast, consists in naught but that men are conscious of their own will while ignorant of the causes

which have induced it." Nördlingen remarked too, that "Our whole life, like our whole organism, is a compound of necessity and freedom." He said: "Man is free, but his hands are bound." Büchner finally admitted, however, that "if there be free will in man, it can be both in theory and practice, but exists in very narrow limits."

Yes, its powers *do* fall in narrow limits, yet it exists in every indirect control by mind-power of the material oscillations. Of this we are assured, and this provides an all-sufficient basis for our theory.

In the sixth century before Christ, Heraclitus asserted that everything in the universe was changing except the Logos, or law of change. He thought that this Logos was the same primeval fire—or the continued formation of a difference, followed by the overcoming of the differentiation. He thought of life as the continued swing of an oscillating pendulum.

What an unsatisfactory idea of life! An ever-living fire, kindling by measure and dying-out of measure! Heraclitus wrote: "Fire lives the death of earth, and air the death of fire. Water lives the death of air, and earth the death of water." Here is the first recorded conception of the futile materialistic cycle to which mechanists have since clung. "The upward and the downward are one and the same. Beginning and end are identical." What a perfect description of meaningless infinity in the pit of which all contradictions and unrealities may be forever buried.

Heraclitus also fathered the conception of spontaneity in Change—the inconceivable thought of something acting upon itself as though from outside itself. Wasn't some sort of explanation necessary? He said that thought arises from the "regulated self-transformation of the universe." And Hegel, almost 2,500 years later, adopted into his *Logic* the self-determining world-creating Logos of Heraclitus, and the latter's identity of opposites (a theory as true as anything else when an infinity of matter is postulated) and the universal procession.

Walter Pater ascribes to Heraclitus a somewhat different view, and at the same time says much himself that is true:

> The continual change to be discovered by the attentive understanding where common opinion found fixed objects, was but the indicator of a subtler but all-pervading motion—the sleepless, ever-sustained, inexhaustible energy of the divine reason itself, proceeding always by its own rhythmical logic, and lending to all mind and matter, in turn, what life they had. In this "perpetual flux" of things and souls, there was, as Heraclitus conceived, a continuance, if not of their material or spiritual elements, yet of orderly intelligible relationships, like the harmony of musical notes, wrought out in and through the series of their mutations—ordinances of the divine reason, maintained throughout the changes of the phenomenal world; and this harmony in their mutation and opposition, was, after all, a principle of sanity, of reality, there.[1]
>
> It was as if, recognizing in perpetual motion the law of Nature, Marius identified his own way of life cordially with it, "throwing himself into the stream," so to speak. He, too, must maintain a harmony with that soul of motion in things, by constantly renewed mobility of character.[2]

Walter Pater wondered whether we did not have a vision "of a reasonable, a divine order, not in nature, but in the condition of human affairs . . . in which, a consciousness of the divine will being everywhere recognized, there would be . . . no more quite hopeless death, of men, of children, or of their affections." He wondered if there were not "an eternal friend to man, just hidden behind the veil of a mechanical and material order, but only just behind it, perhaps ready even now to break through:—were they, after all, really a matter of choice, dependent on some deliberate act of volition on his part?" "Might the will itself be an organ of knowledge, of vision?" "And might not the intellectual frame also . . . be a moment only, an impulse or series of impulses, a single process, in an intellectual or spiritual system external to it, diffused through all time and place—that great stream of spiritual energy, of which his own imperfect thoughts, yesterday or to-day, would be but remote,

[1] Walter Pater: *Marius the Epicurean*, p. 99.
[2] *Ibid.*, p. 105.

and therefore imperfect pulsations?" We must regard "the consciousness of some profound enigma in things as but a pledge of something further to come."

Freedom of the spiritual power is a dim fact. As Professor John Dewey remarks in his *Reconstruction of Philosophy:* "The gist of scientific knowledge is control of natural energies." Speaking of these materialistic philosophers with whose views he does not entirely sympathize, he says:—

> They have insisted that natural laws are themselves moral laws, so that it remains, after noting them, only to conform to them. . . . They apply to Nature all the eulogistic predicates previously associated with divine law; or natural law is conceived of as the only true divine law. . . . In our time this notion has been perpetuated in connection with a *laissez faire* social philosophy and the theory of evolution. Human intelligence is thought to mark an artificial interference if it does more than register fixed natural laws as rules of human action. The process of natural evolution is conceived as the exact model of human endeavor.[1]

The "perception of things as they are," said Professor Dewey, "is but a stage in the process of making them different." That is to say, mental powers control some natural environment-conditions in "absolute" fashion, and here free-will is born, and Conservation receives its deadly thrust.

If human free-will exists to any extent—and all must admit that to-day its limits are narrow—then the gospel of Conservation is no longer perfect. As free-will takes bits from under the huge edifice of matter which man has noted, and which exterior Force has arranged, the foundation of Conservation will weaken perceptibly, until, finally, the structure will be seen to be unsymmetrical and unstable. It will no longer be infinitely real. If the physicist admits the slippage of the first grain of matter, if he admits that some principle outside of mechanics can act to the slightest degree or for the shortest interval of time to alter physical inertia, or to direct its motion purposefully, then he may predict the final crash of the materialistic edifice. Any degree of human

[1] John Dewey: *Human Nature and Conduct,* pp. 260–7.

free-will utterly controverts the axiom of the physical monists. Every exercise of free-will over matter represents an "absolute" event. Free-will exercised within the "boundary represented by material laws" is inconceivable.

Now mind-power has never been discovered by human mind except in connection with brains, but this does not signify that mind-power *cannot* exist separately from brains; that mind has no power over matter; or that mental activities are physical reflexes. Nor does the fact that human mind-power principally concerns itself with restoring the physical equilibrium of the human body signify that every mentally ordained act accomplishes nothing but the balancing of a necessary mechanical routine—a routine that would have occurred in the same way and at the same time had there been only matter in the universe. Nor is the admission that matter forever moves equal to the admission that matter is inherently possessed of motion; or that it would continue to move in reversed cycles if there were only matter in the universe. Nothing in these facts, moreover, discloses matter as a primary character, as many physicists have imagined.

Haeckel was much less a positivist than many of the more stubborn German physicists. Contrary to the belief of Büchner, Haeckel admitted that the material elements might be changed from one form to another. He did not insist that the quantity of each element must exist unchanged forever. We now know that Haeckel's surmise is correct, and that Büchner was wrong in stating that the quantity of every element is necessarily unchangeable. Yet, this incorrect positivism of Büchner's was founded no more firmly than some of the other ideas which he expressed just as dogmatically. Because Büchner had never seen radium turn into lead, and because he judged facts altogether from his scientific experimentation, he was positive that lead was always lead, and that its quantity could never be increased nor diminished. This hypothesis completely collapsed when it became known that radium and uranium both decompose into lead. When it became known that one substance can become transformed into another by what is called a "spontaneous" activity, the most cherished fact of positivism slipped away.

One may well ask: If the Conservation doctrine cannot apply unequivocally to radium, to what particle of matter can it surely refer? If lead is a secondary character, if it may become iron or copper, or if mercury can be transmuted into gold—provided that energy-conditions are suitably arranged—how can science be sure of the final stability and reality of any of the material elements, of any of those combinations of particles (those class-groupings of some permanency) which give us most of our sensations and knowledge of the material, mechanical world? Is the hydrogen-nucleus or the electron forever constant in its physical aspect? Surely we have no right so to believe merely because we have never seen one of them change into something else, or disappear altogether! No single mechanical fact is certainly positive forever!

The Conservation theory, in so far as it relates to any one form of matter, is no longer valid. Nor can we longer distinguish between mass and energy in its unit-form; hence the belief in a materialistic monism—for those who still cling to this faith—is based chiefly upon the Conservation of mechanical momentum. The totality of mass-movement, or total momentum, they say, is indestructible. This is the last ditch of the materialist. But what is motion? If mass is destructible, what becomes of the motion of that which is destroyed? If matter is a secondary quality, what becomes of its attribute of inertia when the matter evaporates?

The primal quality exhibited by the physical universe is motion, but motion is not matter. It is merely an attribute with which matter is more or less "charged". When matter is moved by other matter, the problem of its source of motion has merely been transferred. If motion were inherent in matter, a particle would move independently of its material and mental environment. This it never appreciably does, hence we must accept something immaterial as the cause of its appreciable independent motion.

Haeckel spoke of spirit as an attribute of matter. According to our theory, mind emanates *from* matter, and is, in this sense, an outgrowth from substance. We reverse Haeckel's viewpoint, however, and regard matter as the

secondary character, and spirit or mental power as the primary. Everywhere we see motions which are created to maintain a physical equilibrium of condition in a universe in which matter is disappearing. We also see the movements created by the forces mis-named "attractions", and these motions manifest and measure the restorations of a certain gross type of physical, or mechanical balance. Is it strange, then, that we think of the condition of physical balance as if assured for eternity, and that we regard gravitation as a mystery, Evolution as a final nonentity, and all processes as uncreative and meaningless as the swingings back and forth of pendulums?

Unless we admit the active presence of a general Power, we must, as an alternative, postulate equally unknowable forces which may act at a distance and thus keep the universe self-contained both as a whole and in its parts.

The forces of gravitation and magnetism are supposed by some to be able to keep the universe in balance. The source of power-supply is unexplained, yet many believe that "attraction" is somehow a real attribute of matter, that matter can thus itself create motion by its own power, and that no more explanation is necessary. Yet, these same persons cannot explain motions first in one direction and then in the opposite. This mystery still exists. For one who, because of his circumscribed and utterly mechanical conceptions, fails to imagine a cause of reversed motion, the infinity of space must be postulated, for only by means of the unreal of infinity can the positive motions and "absolute" changes be regarded as meaningless. Even Einstein, as we have seen, cannot describe the bounds of his finite universe in terms of his particular kind of mechanism. By conceiving of an infinity of matter, of space, and of time, some of the mechanical positivists attempt to escape from the unrealities and paradoxes which otherwise followed hard upon their inflexible theory of Conservation—a theory so remarkably combined with the concept of a power of concentration *in* matter, a property which would itself tend to overrule strict Conservation.

Lavoisier formulated (1789) the law of the persistence of

indestructibility of matter in the statement that the sum of matter which fills infinite space is unchangeable. Democritus (about 425 B. C.), who believed in an infinity of atoms, stated the proposition in this way: "Out of nothing arises nothing; nothing that is can be destroyed. All change is only combination and separation of atoms." Haeckel gave the similar law respecting force, thus: "The sum of force which is at work in infinite space and produces all phenomenon, is unchangeable." We may be willing to grant Haeckel's statement if we admit that part of the total force is inert, as in matter; that part is as free as active, as in spirit; and that the moving force of the universe—the spiritual part of it—has, as such, no material attributes whatsoever. This, however, was not his conception. Conservation is not real to us in the strictly mechanical or physical sense in which Haeckel and other materialists have conceived it. We cannot concede that the mass-velocity expression of the universe is infinite, or that it is forever of the same amount. Energy, moreover, is not even defined in the text-books as simple mass-movement, or momentum, or force. Work must be done through appreciable distance before energy can be present.

If the universe were infinite, since infinity cannot be measured, there is no gain in asserting that the mass and energy in it are forever one quantity. Grant this idea of endlessness, and all concepts of limits, of a constant quantity, of sameness, of identity, or measureableness, or of mathematical relationships connecting parts with wholes, become unreal.

No motion is "absolute" in reference to an endless space, for there is then no centre about which movement may occur significantly. Haeckel's dictum that "No particle of living energy is ever extinguished; no particle is ever created anew," is unsound if he refers the energy of mass-movements to any certain point in space, or to the centre of any one finite universe that may be imagined.

After the idea of an infinity of matter was first set forth by Heraclitus, and accepted, the conclusion was obvious. The positivists might well claim materialistic Conservation for such a universe. Yet, no proof of an infinity of matter has

ever been offered. All reason is against the concept, and all facts.

Haeckel saw clearly, too, that the Newtonian formula of gravitation tells nothing of its nature, and that the idea of an "attraction at a distance" is impossible.

> The action at a distance without a medium which Newton deduced from his law of gravitation, and which became one of the most serious and dangerous dogmas of later physics, does not afford the slightest explanation of the real causes of attraction; indeed, it long obstructed our way to the real discovery of them. [1]

Similarly Professor Poor says:

> This law of gravitation was deduced from experience, from experiment, and does not attempt in any way to explain how the force acts or why it acts; it merely states that such force does act, and in acting, follows a certain definite mathematical law. [2]
>
> The force of gravitation, the attraction of the sun, keeps the planets in their respective orbit, but it does not explain or account for the original motion, for the muzzle velocity of the shell, so to speak. Once the planets were set in motion about the sun, gravitation took charge and regulated and controlled the various paths, but, somehow, in some inexplicable way the system was set in motion and each planet given an initial velocity. [3]

Haeckel, however, sympathetically viewed the theory of J. C. Vogt that the "primitive force of the world . . . is not the vibration or oscillation of particles in empty space, but the condensation of a simple primitive substance, which fills the infinity of space in an unbroken continuity. Its sole inherent mechanical form of activity consists in a tendency to condensation or contraction." The "centres of condensation . . . correspond in general to the ultimate separate atoms of the kinetic theory." "Moreover these 'atoms with souls' do not float in empty space, but in the continuous, extremely

[1] *Ibid.*, p. 217.
[2] Charles Lane Poor: *Gravitation versus Relativity*, p. 69.
[3] *Ibid.*, p. 113.

attenuated intermediate substance, which represents the uncondensed portion of the primitive matter."

Our own theory is similar and dissimilar. In our view, the primitive substance is spirit, and matter is a particular arrangement, or condensation, of spirit. Spirit has "soul" in the sense that it can move matter with purpose. Spirit purposes to destroy this condensed and passive formation of matter. It does so by causing motions and collisions in a limited area—and not in a meaningless infinity.

The universe of matter is divided by Vogt and Haeckel into ponderable inertness and an imponderable source of activity. There is dualism in the idea of ponderable and imponderable substance; and there is an Evolution, too, if one presupposes the result of the action of the imponderable upon the ponderable. Haeckel felt that the old kinetic theory was untenable, for he could not imagine that there are vibratory atoms which first leave one another against "mutual attractions" and then reverse their motions by virtue of those same mysterious forces at a distance. For this reason he found considerable satisfaction in Vogt's theory. In fact, Haeckel arrived at a definite conception of the ether as such an imponderable medium as Vogt described—a medium possessing even the power of concentrating matter, and of giving motions to it. Ether was supposed to be able to cause motion, even though it was imponderable in the sense that it had no physical inertia—not even the inertia of gas. The ether of Haeckel is almost the same thing as the external mind-power or "spirit" of our theory; but we differ from Haeckel in that we deny Conservation, and we believe also that the evolutionary changes of life are obtained positively by purposed movements caused by an imponderable and spiritual essense, which, as such, *has no material qualities whatsoever.*

Haeckel said:

> The two fundamental forms of substance, ponderable matter and ether, are not dead and only moved by extrinsic force, but they are *endowed with sensation and will* (though, naturally, of the lowest grade); they experience an inclination for condensation, a *dislike* of

> strain; they strive after the one and struggle against the other.[1]

In our view, only the etherial essence of the mental realm is endowed with the ability to create motion, and matter, the negative of the mover, is that which is moved. Even when it is admitted that there is a mover subject and a moved object it is almost impossible to tell from a study of the movement that the thing moving has been moved by a power outside of itself. But, if "sensation and will," and "an inclination" and "a dislike," may be attributed to ether, then we can easily discover in this ether our conception of spirit, or mind-power—and also a power to do and move.

Haeckel said that the "part of space which is not occupied with ponderable atoms is filled with ether." Mind-power, too, may envelop the matter of the universe, and express its will with it. As Haeckel said, "There is no such thing as action at a distance through perfectly empty space; all action of bodies upon each other is either determined by immediate contact, or is effected by the mediation of ether." We agree that there is no gravitational tendency that may be properly described as an "attraction." Force is derived either secondarily, that is, from other moving matter; or primarily, from an immaterial Power with Will and Purpose. Either the spiritual essence moves matter, or else the body is moved by contacts with others through a chain of motions, the beginnings of which, in every case, were induced by the spiritual or mental cause of motion. To escape from this conclusion, some of the physicists have even suggested that motion has no beginning.

Haeckel called himself a monist because he described matter and his remarkable ether in terms of substance. He said that both follow the laws of substance, and that both are changeless in quantity. Yet the ether of his definition has will and the ability to make matter move, and no *discoverable* inertia. No one could better define the primal spiritual essence. Haeckel's greatest error is that of overlooking the significant fact of Evolution.

[1] Ernst Haeckel: *The Riddle of the Universe,* English translation, p. 220. Italics mine.

Haeckel said that his ether has "a special structure which is not atomistic, like that of ponderable matter, and which may provisionally be called *etheric* or *dynamic* structure." (p. 227) He also said that ether is neither gaseous nor solid, and that "if it really has weight, as is very probable, it must be so slight as to be far below the capacity of the most delicate balance." (p. 228) He divided matter into five states,—solid, viscous, fluid, gaseous, and etheric. The first four subscribe exactly to our own definition of "matter", and the fifth—if we forget about the indiscoverable mass—is without inertia, and is altogether mental or spiritual in its nature. It seems strange that Haeckel conceived that the first four states might be changed one into another, but did not think of the possibility that all ponderable matter might be converted into imponderable ether. Had he done this, he would have gained a concept of great significance.

To Haeckel, ether is "boundless and immeasurable; like the space it occupies. It is in eternal motion; and this specific movement of ether (it is immaterial whether we conceive it as vibration, strain, condensation, etc.), in reciprocal action with mass movement (or gravitation), is the ultimate cause of all phenomena." (p. 228) Gravitation is "impossible unless the ether effects the mutual attraction of the separated atoms, because we cannot admit the idea of *actio in distans.*" (p. 230) He infers here that somehow ether causes the condensing tendencies known as the "attractions" of atoms, and here again he comes close to our hypothesis.

It is remarkable that after endowing his ether with the independent power to cause motion, and after giving it "will" and "inclination" and "dislike", he should yet assert that it had the characteristics of substance rather than of spirit. He virtually postulated a dualism of qualities that is complete though he denied this dualism. Nothing could be more opposed than the "inclination" and "power" of his ether, on the one hand, and the sluggish inertia of his matter, on the other; but he denied that these oppositions constituted a significant difference—the difference between matter and non-matter. Yet the dualism which he described possesses

as much significance, as much opposition in quality, and as much potentiality of "absolute change", as need be sought for.

If Haeckel had granted us a finite universe, and had then assumed that the four stages of ponderables could be converted by re-arrangement into the condition of his imponderable, his theory and our own would part company on nothing more vital than a slight difference in the definitions of matter and non-matter, and in the locus of the moving powers. It is true that Haeckel suggested vaguely that ether had mass, but, in the same breath, he attributed immaterial properties and powers to it. It fortifies our belief to feel that it is so close to the conception of this great German thinker.

Now, Haeckel was not the only one, as we have seen, who asserted that ponderable matter could not possess the power of "attraction." Herbert Spencer said:

> Newton himself confessed the force of gravitation to be incomprehensible without the intermediation of an ether; and, as we have already seen, our assumption of an ether does not in the least help us.[1]

No! The mere presence of an ether without positive powers, without will or inclinations, does not help to solve the problem of gravitational "attraction"; but the conception of an ether such as Haeckel described, possessing will, volition, and purpose (and the power to anticipate motions and situations and conditions that do not then exist, but which will exist later), and acting on matter from the outside, and even able to make matter move, condense, and collide, does perhaps hold an explanation of gravitation. It *will* explain gravitation, in truth, provided that we add a significant Evolution to the picture.

Some persons, as we have said, seem to believe that the substitution of an electromagnetic field for ether helps to explain gravitation. This, however, is not correct. To explain gravitation, or magnetism, or general cohesion of struc-

[1] Herbert Spencer: *First Principles,* p. 94.

ture, one must attribute to this electromagnetic field not only the mechanical property of inertia but also such unmechanical properties as will, inclination, and anticipation, and some ability as marvellous as that of exercising force at a distance. Or perhaps one must attribute to the "field" the power of causing variations in straight-line motion because Time in this field is mysteriously changed by motion. The electromagnetic field must be given either the attributes of Haeckel's ether, or the unreality of Einstein's Relativity, if it is to explain gravitation; and, if we can go to such lengths mentally, the electromagnetic field is found to be an unnecessary part of the concept.

It is much more logical to believe with Haeckel in a spiritual ether with power than to postulate a change which is unexplained as to cause,—a change which is self-originating, which sprouts out of no soil, which is "spontaneous" and yet persistent, and which represents an action that is self-reversed in an infinite space merely because it so happens, and not because it *must* reasonably be. What can be more unbelievable than a premise which first accepts the doctrine of the indestructibility of matter and motion as they exist meaninglessly in infinite quantity in an infinity of space, and then affirms that there is a purposeless concentration of this matter within this infinite volume, and that all of this is brought about by a power as inconceivable as a force acting at a distance? How can self-created change possibly spring out of a rigid law of equal action and reaction? But an ether with inclinations and powers, with plans for the future, and with purpose, can quite overrule a Conservation doctrine which is supposed to be related only to the ponderable part of the universe.

Henry More (1647-1687) held that the motion of matter could be explained only on the assumption that there is in the space exterior to physical matter a spiritual substance which produces the motions of matter. Newton himself in his *Optics* wrote "Does it not appear from phenomena that there is a Being incorporeal, living, intelligent, omnipresent, who, in infinite space, as it were in his sensory, sees the things themselves intimately and thoroughly perceives

them and comprehends them only by their immediate presence to himself."[1] In his *Principia,* Newton says that God "constitutes duration and space". And Campanello (1568–1639) regarded space as an "independent spiritual being endowed with consciousness and with immortality."

And George Morehouse said:—

> Changes are everywhere taking place. The forces producing, accompanying, and resulting from these changes are found to be constant quantities. There is always an exact relation between the forces exerted and the results attained. No power is ever gained or lost.[2]

Such changes are as difficult for the imagination and reason to grasp as the concept of the beginning of the universe. A variation is supposed to take place although there is no cause for it. Indeed, the self-contradictions of this rigid physics afford good proof that the doctrine of the physicists is unsound even in its rigidity.

In earlier pages we reached definite conclusions about the powers and relations of matter and mind. In still other pages we considered some mechanical laws, and, after analyzing them, we concluded that neither Space nor Time participates in events, but that these principles refer only to unaccomplishing movements through voids. We concluded also that neither matter nor the consciousness due to sensations is continuous. Matter as it exists, and as its blows give us sensations, is discontinuous. That consciousness which appears in us as the direct result of associations with the blows of discontinuous matter does not exist constantly in Time. These conclusions being granted, it is inconceivable that force can in any way be altered by mere change in distance *per se,* or that Time itself can be so changed by relative motion as to destroy any of the "absolute" motions and forces of material particles. If forces cannot be altered by mere changes in distance, and if forces cannot act "at a distance," then gravitation, magnetism, and cohesion are unreal as at present

[1] Sir Isaac Newton; *Optics,* Book III, Query XXIX.
[2] George Morehouse: *The Wilderness of Worlds,* p. 19.

explained. And if forces cannot be altered by changes in Time, Einstein's theory of Relativity becomes unreal as an explanation of the unexpected curvature of light. Lastly, we have denied physical monism, and have affirmed a significant Evolution in which matter is transformed into an ethereal or spiritual form—something like the ether described by Haeckel—which has the will both to move matter and to restrain the movements within bounds.

The modern scientist makes his concessions to the idea of a rigid materialism; but he usually does so without defining the philosophic importance of his admissions. Often he thinks his foundation is completely materialistic when his assumptions have partly denied this possibility. A theory is largely a matter of definition. If one thinks that the "charge" of motion which gives matter its moving energy is of materialistic character, if he so defines substance as to include independent ability to alter motion through empty space as one of its attributes, and as able to arrange itself in the present so as to adequately meet a future condition, then he has so blended the material with the spiritual that it is impossible to see the distinction that some other set of definitions might draw. If, however, motion is entirely a spiritual product, then the energy of motion is entirely spiritualistic. When, however, matter moves, when substance is thus "charged" with spirit, some even claim that both matter and motion contribute to the manifestation of what is known as mechanical energy.

My muscles and my mind together make my typewriter produce words. Both are necessary if this certain effect is to be produced; and yet they are separate realities. Nor has one the right to say, as does Haeckel, that the matter of the universe might disappear, and that the *pure* energy (mechanical energy imagined as somehow existing without matter) might increase correspondingly, and then, that this energy of itself is a materialistic entity, and subject to measurements in mechanical terms. Only the matter-part of the dualism is really mechanical. Its "charge of motion" transcends mechanics. Even if the total energy-manifestation of the dualism—matter plus motion—should increase up to

certain limits, this fact would not alter the double truth—namely, that the materialism of the universe is diminishing, and that the spiritual element is increasing.

When, therefore, the scientist concedes that the amount of matter is decreasing, he himself has, according to our view, indirectly admitted that the mechanical Conservation doctrine is unsound. Thus the well-known American astronomer, Professor Henry Norris Russell, writes: "Astronomers have come to believe that the very substance of the stars—the matter of which they are composed—is gradually disappearing and being replaced by energy."[1] This remark conforms with our theory that energy is altogether a spiritual force. It denies mechanical Conservation, as we see it, and admits that which we have asserted. How can it be otherwise? For when there is no matter remaining there will be no mechanical energy for the physicist to measure. Professor Russell says, too: "Irreversibility is written wide and deep upon the face of nature," and again: "Most completely irreversible of all would appear to be the newly discovered process by which matter is turned into free energy."

If the physicist will only use a sharp cleaver to separate the two characters of the dualism as they confront him in every-day life, and to distinguish the inert space-demanding body known as matter from the imponderable power that causes it to oscillate within certain restricted bounds, and according to certain conditions, he might dispense with his principle of Conservation, so consistent and comfortable for his everyday problems relating to the interior of the physical pool, and thus gain a conception that might dissipate many of his mysteries.

The idea that unit-energy passes from particle to particle *immediately* serves, moreover, to clear up our ideas of other events which have always seemed incredible as described. We have never been able to conceive of a continuous expression of energy, and now we realize that there is no such thing. Continuous impact—that is to say, continuous transfer of motion through the principle of inertia—postulates an infinity of altogether solid matter to do the striking Ob-

[1] *The Literary Digest*, December 26, 1926, p. 16.

viously, however, this idea is unreal. Continuous energy, moreover, could not be formulated in a number-system, for it would have no finite unit. It is utterly impossible (as stated in Chapter II) for a pound of weight to be a continuous force-expression. The "weighing" force is expressed at intervals. Part of the time a weight does not "weigh". This fact, itself, affords proof that gravitation is merely an unperceived effect of the unbalanced blows of myriads of striking particles. These discontinuous particles act so rapidly, we believe, and deliver such small quantities of energy at a time, that the blows are not realized, and only the total energy-effect of a comparatively long duration upon a certain class of objects is calculable. The force of a weight *seems* to be expressed continuously, but, as in the case of the moving picture, reason proves that the action is discontinuous.

In subsequent chapters, I shall venture further with my theory of gravitation—of a gravitation created by the blows of corpuscles which move in unbalanced fashion because of Evolution. More and more we shall find that all the significance of life is drawn from Evolution. The conduct of worlds subscribes on the average to the fact of evolutionary Change, just as the laws of society—if they are to prove beneficial in the long run—will be founded on the principle of the survival of those who are fittest to survive in the evolutionary struggle. That is to say, the conditions and laws must preserve those who are best adapted to persist amid the evolutionary changes in their environment, and who thus have the greatest ability to master the influence of the surrounding physical waves.

The evolutionary theory should also offer satisfying explanations of the paths of the planets around the sun. In this discussion we shall be concerned with technicalities, mathematical formulas, the proper use of numbers, and with the significance of the fact that discrete numbers *can* be used to formulate forces. These specific problems will prove less than entertaining to the usual reader. We shall try, therefore, to touch upon the most essential details only. Generalities glitter more than details, and yet, if a theory

is to have any acceptance, it *must* attend largely to the details. In another book, I shall spend tedious hours over those particulars which may possibly interest some, but which will inevitably prove wearisome to the general reader. As to the present work, it must be shortened as much as possible, hence the other chapters will contain only those confirmations of the theory which appear essential.

CHAPTER XIII

COMPARISON WITH THEORIES OF KANT AND SPENCER

For the whole world, with all its phenomena, is the objectivity of the one indivisible will, the Idea, which is related to all other Ideas as harmony is related to the single voice.

SCHOPENHAUER.

We have seen in the last few chapters that invalid reasonings from experiences in gross have caused us to form improper conceptions of Space and Time, and to relate them improperly to events, to changes, to Evolution. This fallacy has strongly influenced those who have regarded the old laws and formulas of science as unquestionable, and who have based their theories upon these unsound foundations.

If, however, Space, so far as it relates to real physical characters, is merely the extension of the unit-particle, disappearing as the particle disappears, and moving with the particle; if the volume between particles is a physical nothingness, and has no place in mechanical formulas relating to energy-transfers; if Time, so far as it relates to physical characters, refers only to the duration of matter as it moves or remains at rest; if neither Time nor Space participates in the mechanical events of life; if both Space and Time, in so far as they refer to mechanics,—Space to the extension of the physical bit, and Time to its uneventful movement,—will vanish when the matter to which they pertain has vanished; then, some of the philosophies founded on different ideas are invalid in principle, as are also the mechanical formulas which imply that Space and Time take part in energy-transfers.

Extension, an attribute of the unit of matter, represents an entirely physical property, just as do hardness and round-

ness. Like inertia, extension is a secondary quality, for it is real only while matter exists. Like Time, it does not enter mental realms except indirectly; nor does it directly contribute to sensations. We may say that extension relates solely to the unsensed interior being of the solid unit, and that the Time of mechanics relates only to its uneventful duration. As Professor William Brown has said: "Truth, as truth, is certainly beyond time." And again: "If we assume that time is completely real for us, that we are bound down in a time process, and that we do not transcend it at all, then our ultimate outlook upon reality is very depressing and unmeaning." [1]

Professor Josiah Royce says that the first half of Kant's critical philosophy was founded on his concept of Space and Time. If these thoughts contain error, his philosophic theories are equally unsound. "Know what space and time are" wrote Kant, "and you will know something about the truths that condition the world's very existence." [2] Yet, when we study the theories of Kant, how incompatible with simple everyday truths his concepts are, and how involved and unreal they seem! Would one with our fairly definite ideas of matter, energy, and space have made this remark: "Whatever matter there were in the outer world, there would in any case have to be space to put the matter in, and so the laws of matter have to conform to the laws of space." [3] And again: "Nature must perforce obey geometry; else could she get no room for her things, and even so with time." [4] What can be meant by "nature obeying geometry"?

Kant said: "The laws of space come first in order. The law of physics comes, as it were, logically later, and must be congruent with the space laws. But space, on the other hand, is not obliged to conform to the laws of matter." [5]

Do statements like these mean much to one who has accepted our definition of extension? What hazy concept of physically real space-contents is in the mind of a man who

[1] Various Writers: *Science, Religion and Reality*, pp. 324–5.
[2] Josiah Royce: *The Spirit of Modern Philosophy*, p. 122.
[3] *Ibid.*, p. 122.
[4] *Ibid.*, p. 122.
[5] *Ibid.*, p. 132.

would say of it that it "is not obliged to conform to the laws of matter"? And what present interest have we in space-contents which is not made physically real by being filled with physical matter?

What, then, were Kant's ideas of space and time? Again, I shall use the interpretation of Professor Royce:

> About 1769, it occurred to Kant to observe that both time and space are, when regarded as real things, thoroughly and hopelessly paradoxical, self contradictory in their nature. . . . Kant found that, if you once regard them as realities, as facts existent outside your own mind, you can make diametrically opposed assertions about them, and yet prove both of a pair of such assertions to be true. . . . Of space you can say that it is infinitely divisible, that is, that cut it up as small as you like, the parts will still have size, and so can be cut again, so that you could never reach the end of cutting. This you can say, and you can prove it too, if, namely, space is a real thing that stays there to be cut, apart from your ideas of it. Equally certain it is, however in case space is real, and is made up of parts, that then, if you let it in conception crumble away like a heap of sand, to find what in the last analysis it is made of, there must be found somewhere ultimate parts, real space-atoms, which you could reach by this process of ideal analysis, and which you couldn't divide. . . . Therefore, if space is a reality, you can prove, thinks Kant, that it is infinitely divisible and that it isn't infinitely divisible. That seems absurd, but what does such an absurd result prove? It proves, so Kant holds, that space isn't real at all, but just an idea of yours, a universal but inner condition of your consciousness of outer objects. This result is revolutionary for him. Space and time, he had already said, are the conditions prior of all physical nature. And now space and time can be thus proved to be unreal outside of our minds. What follows? The whole of this seeming outer nature is no outer fact at all. It is a mere phenomenon in us.[1]

Kant asserts, then, that matter does not exist to the mind as necessarily real outside of the mind, and that "outer nature is no outer fact at all". Why? Because he thinks he

[1] *Ibid.*, pp. 122–4.

has discovered an unconquerable paradox in his or any other man's concept of space and time as pertaining to matter, and thus as being known directly by mind. But is this true? Suppose that space, except as it refers to matter, is indeed nothingness, just as there is no inertia except where masses are involved, does this destroy the reality of the physical extension within the unit of matter itself? Suppose that matter is itself everything that is physically measurable or tangible, or that is capable of participating in mechanical operations, and that we use the word "extension" to define mentally the spatial projection of the inert "thing-in-itself", just as we use the word hardness to define another of its qualities. This unit, then, is surrounded by a nothingness, both of extension and hardness, and of mechanical possibilities as well, hence there is only nothingness between it and the next particle, and no physical character, or property, or possibility of a mechanical manifestation.

The unit-particle itself, we contend, is mental in its interior quality; but this need not concern us in physics, for as long as this mental essence is enmeshed in the material arrangement it is orthodox substance in every sense. And only this inert arrangement known as substance has dealings with physical space; only it has mechanical inertia. When the mental essence is separated and free, this vital energy, this driving force of the universe, appears to make no more use of extension than it does of hardness. Space and Time, then, normally have meaning (in physics, at least) in reference to the composite-physical, and mind knows them only because it "knows" matter in the ways outlined. The universe is finally to be monistic—mentally monistic—but at present it is a dualism of arrangements; and the unwillingness of the corpuscle to be disrupted, its rigid solidity as it were, and its obedience to mental orders to move, so long as it can but move as a whole,—all these, its physical characters, are created as if solidified out of something mental. These qualities are derived temporarily from a character which, when taken by itself, represents physical nothingness. Just as the qualities of steam disappear when it is condensed into

water, so the activity and invisibility of the mind-power are not expressed when it is condensed into matter.

To the ignorant savage the creation of a visible fluid from an invisible gas is an incomprehensible phenomenon, and he would understand it as little as we understand how inert matter can be composed of imponderable mind. We are prone to regard descriptive words and formulas that give consistent results as if they were explanations; yet we are almost as ignorant of fundamentals as the savage. We do not know, for example, what heat is, or why evaporation occurs when heat is added to water. We also fail to understand that matter might be nothing more than an arrangement of mental power of less than eternal permanence.

From the time when active mind-power, from some unknown cause, became locked in the passive form of substance, the universe has consisted of two principles subject to distinctive definitions—not of one character only. The processes of the universe—at least those which we are aware of as processes—and the regular movements which we formulate, are merely the phenomena attending the change of this dualism (really a dualism of arrangements) into a unity. During the time that this process continues, and so long as substance exists unresolved, an opposition of distinctive qualities will be manifested. And, during the time that part of this mind-power is condensed into inert matter, we cannot deny that the active mind,—the immaterial part of this seething dualism,—"knows" the other half. We here disagree with Kant. Mind outside of matter does not "know" the *heart* of the smallest matter-body directly, perhaps, but surely it may know indirectly, through general reasoning, all about the arrangements of this smallest bit into structural forms; and it may realize, as well, the intrinsic properties of the material thing. In fact, it may some day know as much about matter as it needs or cares to do.

We may be sure that the arrangement known as matter now exists; but its composite motion-qualities are expressed, real, and actually vital to us, only when an active mind-power comes into relationship with them. Where the unit-particle is there the qualities of extension, inertia, and solidity are

potential; but when the particle is moved and strikes our bodies, it becomes real to us, not in itself,—not even, so it seems, as one unit-relationship with mind,—but by its repeated deliveries of motion, by the unrealized resultant changes in our bodies, and by the very creation of mind-power within us. This mind-power within us, moreover, is conscious of the physical characteristics of the composite motions against our bodies because it is aware of the enduring changes caused thereby in the physical structure of the body which the mind itself makes active. To this important extent, mind knows the qualities of matter directly—in part as conscious recognition of the rhythmic composite sense-data, and in part as subconscious appreciations of the unit changes in the physique of the body.

Speaking from the point of view of mind alone, except where there are motion and its change, there is nothingness; but, speaking from the physical or mechanical standpoint, there is no reality except where there is a matter-particle. Matter, for the most part, moves in a quiet changelessness. Time is consumed while it passes from place to place, and also in the duration of its monopoly of space; but the life of man, the life of his mechanical sensations and experiences, is possible only because meaningless quietude is not permitted except in the tiny intervals between collisions. By means of these instantaneous contacts life becomes productive of thoughts of the physical environment—of thought generated out of matter instantly by motion. The active but intangible mental power, the font of all energy and motion, appears to require neither time nor space for its energy-expression. It appears to have neither inertia, extension, solidity, nor any other material character. Where there is no matter there free mind-power may be, but, in a corporeal sense, the absence of matter means that nothingness obtains.

Evolution, the unfailing associate of the greatest of human realities (and almost to be regarded as the cause of them, but itself, after all, a product of repeatedly *created motions*) is sufficient evidence that the material arrangement is temporary, that all physical attributes are impermanent. Matter seems destined to disappear—and even now it is grad-

ually vanishing, producing thought as it dissolves, and giving thought meanwhile a changing environment to dwell upon. The spiritual power is slowly taking possession of the universe. Indeed, the voids in physical Space, and the maximum velocity of light, now seem to represent (and even measure) the presence of, but also the lack of omnipotence in, the cause of motion.

Here is man, then, living in the midst of this transformation, himself partly a mental and partly a physical being, the spiritual steam of him formed from the blows of matter, and from their disruptions and transformations. He is acquainted—and in one sense intimately—with part of the physical world, and he especially perceives the typical messengers which strike in regular series against his body. He is aware also of that mental power within him which seems to make no use of space and time. Through the repeated transformations of matter into mind, through the physical and mental evolutionary changes which he momentarily experiences, he finds himself in the midst of sensational events. He is intimately, consciously, and repeatedly associated with evolutionary changes within his own physical being, and with the effects made in his body by the rhythmic impressions received from his world-environment. All this makes his existence significant—even possible!

Although the mind of man receives messages from the entire universe in its typical, widespread processes of Change, he misconceives the reality of that which he perceives. He denies the Change that makes his mental life real, and predicates nothing but mechanical Conservation. Then he comes to believe that he is surrounded by an unfathomable paradox —that his mind-power can never connect directly with the realities of the physical world. He concludes, indeed, as David Hume taught, that the mind can never "know" the nature of matter either directly or in any way. Thus credulous man comes to his final fallacy: He thinks he can never know enough to predict the necessary doings and changings of matter—and much less explain them.

How incorrect! The distinctive properties of matter—consisting principally of different series of unit blows at dif-

ferent velocities—are displayed through motions and their contacts, through the association with impacts and disruptions, through the objective inertias and resistances to motion, and these relationships are brought about and are revealed to knowledge through transforming Change. The mind may never look directly into the heart of the unit bit of matter, but it does not follow that the mind may never recognize imaginatively the nature of the interior inertia of the mass which the mental power moves. And mind-power should be aware of extension and solidity in every structural arrangement possible to the unit parts. It should be acquainted with all the typical structural forms. Furthermore, as matter is transformed into mind, and as the newly created mind takes up the task of directing its body in its physical relationships, it should, if it were perfect, realize every physically significant attribute of the body-corpuscles and also every attribute of the formations driving in against the body. Surely the association is sufficiently intimate. One who attributes to mind the power to move the matter of its own body can hardly doubt the mind's ability to acquire a complete knowledge of that matter which affects the body.

The mind in control of a body learns something when exterior matter reaches the body with affecting and regular series of blows; and again it learns about matter when it moves this changed body which the blows have altered. As adequately as the body has typical series of physical impressions, or as mind moves matter, the mind "knows". It knows its physical environment just as a spiritual steam might know the material engine which it operates. No *a priori* concepts, such as Kant postulated, are needed. And other knowledge comes to the mind from its own characteristic power of general reasoning and analogy. The law of limited opposites, moreover, should impart to the mind the additional understanding needed for almost full comprehension. It is partly by making use of this principle of opposites that the mind may know something of the nature of the heart of the unit-particle.

We therefore find little soundness in the doctrine of Hume which so influenced Kant. Nor do we find those contradic-

tions which Kant thought to have identified when he imaginatively sub-divided the unit of extension ever further. In our different definition of matter, where is his perplexing paradox to be discovered?

The unit-particle has been defined as the unit of extension, just as the particle itself is the unit of matter. The two—the temporary thing and its inherent quality—are bound firmly together; but one disappears when the other is transformed. There is no substance, and no field of mechanics, between the particles. The total extension—in so far as extension is real *physically*—of a large body is the added extensions of all its unit-parts. The void between particles would not be conceivable were it not that they remain (in the average) a certain distance apart.

Having thus defined extension let us proceed to divide mentally that which possesses it. When we attempt this division we immediately encounter the definition of the unit of matter which tells us that this division is impossible if the physical characters are to be retained. When the unit is once divided, its one significant change has been accomplished, and no further material existence remains for it. Nothing of the physical (not even physical extension) remains to be opposed to that which it was before this division.

The idea, itself, of an infinite mechanical subdivision of the unit of matter is thus seen to be the unreality. We can separate particles of matter, and thus increase the time required to bring them together with a certain use of motion, but from the standpoint of physics the volume which the unit-particle occupies is indivisible. As well might we expect to divide a sphere and have a sphere as divide the very smallest bit of matter and have pieces that are still material. If the smallest particle is once divided—and it is the only *real* physical subdivision—a new power appears with new qualities. This is the fundamentally new concept that we must grasp. By adopting it, by admitting that in its only possible division matter may be transformed into non-matter, we shall escape the paradoxes of Spencer and Kant, and shall avoid many perplexities.

Indeed, it may be possible that in this concept there is a

satisfying explanation even for the mechanical mysteries—gravitation and cohesion; for the mental mysteries—the paradoxes of space and time, and the natures of knowledge and reality; for life-mysteries—the nature of Evolution and of the conscious existence that accompanies it. Perhaps all of these difficulties, even the idea vaguely behind the unreal concept of Time as a dimension, may be clarified by the hypothesis of transformation. One after the other we shall relate this theory to these problems, but, just at the moment, let us further consider the ideas of Kant and the philosophy which he erected upon an erroneous concept.

At the very beginning of his reasoning, Kant, having taken the wrong mental path, wandered, inevitably enough, into a confused wilderness of unreal ideas. He believed that matter did exist, even though we might never know "the thing-in-itself." He thought both substance and mind-power existed—the former changelessly. He believed, therefore, in a permanent rather than a temporary dualism. Then, like Herbert Spencer, he thought only of a continuing subdivision in kind—as if this were the only possibility—and, like Spencer, he quickly found himself in the midst of contradictions from which he could see no escape.

Both these thinkers were confused by the unreal idea of a mechanical Conservation. Spencer described several of his mental difficulties, and urged that they were forever unexplainable. Kant called attention to these same general oppositions, but insisted that, since the qualities of matter were illogical as the mind viewed them, the mental power did not treat with matter itself. Therefore, he said, substance can exist to us only as a mental fabrication. It may exist, but we cannot be sure of this from any mental knowledge of it.

> In 1770, he stated this theory of the subjectivity of time and space, as he called his notion. . . . Space and time can't be real, Kant now says, for we know too much about them, know them, not by bare observation, but with a mathematical completeness such as we couldn't possess with regard to outer facts, know more than we could have found out if they existed really beyond our-

> selves. We know, for instance, of time and space as they are for our minds, that they are infinite wholes, prior to any of their own parts as well as to the things that exist in them. Furthermore, as you can easily see, space and time don't seem to us to be properties of things as color and taste are; nor yet are they separate things of nature. Rather are they just conditions of our sense-knowledge of things. So, then, they can't be real at all, except as facts of our consciousness. Kant therefore calls space and time forms of perception, or sense-forms. Our world seems to be in space and time because it is our own nature to view it as spatial and temporal. Space and time appear to us to belong outside us, merely because they are conditions in us of our seeing and feeling things, forms of our sense.[1]

We see how rapidly Kant is immersed in the vague, the metaphysical, and the unreal. He has reached just the opposite of truth because his first premise contained this opposition. He asserts that space and time are known entirely as forms of the mind, and as associated by the mind with sensations, whereas to us they appear to have no direct association either with the mental aspect of our sensations, or with the separate energy-deliveries composing the sense-data. They are not "facts of our consciousness" except indirectly. Space refers to, and belongs to, the extension of the unit particle of matter, and only to it so long as it remains matter. Nor can we be sure that the mental makes use of space or time in its own activities. Certainly no space or time participates in the separate but indirect transfers of mental power from particle to particle through moving contacts. From his mistaken premise, Kant, however, proceeds, logically enough, into greater unrealities. He says:

> . . . the things as they are in themselves, since they can't be spatial, nor temporal, are in fact utterly unknowable. Nobody can prove the least thing about what the real world is. . . . We know also that there are things beyond us which we view through our sense-forms. But what those things are, how should we ever find out? . . . But thus, you see, we have found a limit to science.

[1] *Ibid.*, pp. 124–5.

> It can never know things in themselves. And so Kant's critical doctrine ultimately came to be one of the necessary limits of all theoretical thought.[1]

Poor Science! From her Kant obtained his first facts. From these, incomplete as they were, he drew incorrect conclusions, and then he used this mistaken logic to fetter Science. Only slightly acquainted with Science, and probably jealous of her pretensions, the metaphysical philosopher is perhaps comforted in the thought that he himself has staked the bounds past which science may not move.

Science scarcely stirs, it is true, without the aid of imagination; but, regardless of the assertions of Kant and Spencer,—and of Hume, too, who denied any necessary sequence in mechanical realms,—Science is little worried about the metaphysical dictum that insurmountable barriers to greater knowledge have been encountered. Instead, she goes placidly ahead, her great achievers combining imagination and experience more and more in practical ways. More would now be accomplished, more mastery and knowledge of outside nature would now be displayed, were mind-power stronger. The imagination moves but feebly, and too much of our supposedly exact knowledge is gained inexactly and mistakenly from trial and error methods concerned solely with gross experiences.

Experimental composite findings, incorrectly interpreted, established those false mechanical hypotheses which led to Kant's erroneous ideas of Time and Space. It seems ironical that he should conclude that the most sublimated mental power can never understand the material world when he based these conclusions, not upon mentally derived principles, but upon the provisional and erroneous law of Conservation. Remove Kant's false premise based on faulty experiment, substitute instead an hypothesis derived more from reason than from the erroneous appearances of certain types of sense-data, and his own reasoned-out thought-structure collapses.

In fact, perfected mentality, or knowledge—the type of

[1] *Ibid.*, p. 125.

mind-power and knowledge that Evolution acting through time seem gradually to be producing—should finally comprehend all the workings of the physical universe—and even largely control them. Certainly, we cannot agree with Kant that this world of matter is "entirely unknowable."

Kant thought it possible to subdivide indefinitely the extensions which compose the material world, and, thinking of this subdividing, he reached finally what he regarded as an *impasse.* Then, instead of inferring that his idea of extension was incorrect, and that real extension is physical, not mental, temporary not permanent, unitary or not at all, and an attribute which lasts only so long as the "thing-in-itself" lasts, he concluded that all exact knowledge of extension is impossible, and that Space and Time are but mental images.

David Hume perceived that there was a fallacy in this sort of reasoning, for he wrote in *An Enquiry Concerning Human Understanding* (section XII, part 2):

> No priestly *dogmas,* invented on purpose to tame and subdue the rebellious reason of mankind, ever shocked common sense more than the doctrine of the infinitive divisibility of extension, with its consequences; as they are pompously displayed by all geometricians and metaphysicians, with a kind of triumph and exaltation. A real quantity, infinitely less than any finite quantity, containing quantities infinitely less than itself, and so on *in infinitum;* this is an edifice so bold and prodigious, that it is too weighty for any pretended demonstration to support, because it shocks the clearest and most natural principles of human reason. But what renders the matter more extraordinary, is, that these seemingly absurd opinions are supported by a chain of reasoning, the clearest and most natural; nor is it possible for us to allow the premises without admitting the consequences.

And Hume even seemed to perceive—almost intuitively—the fallacies in those mathematical formulas (especially those involving the notions of infinitesimal entities) which we shall consider in later chapters of the book. He merely mentioned his general objections, however, and left the problem for the investigations of others. Thus he said:

> Nothing can be more convincing and satisfactory than all the conclusions concerning the properties of circles and triangles; and yet, when these are once received, how can we deny that the angle of contact between a circle and its tangent is infinitely less than any rectilineal angle, that as you may increase the diameter of the Circle *in infinitum,* this angle of contact becomes still less, even *in infinitum,* and this the angle of contact between other curves and their tangents may be infinitely less than those between any circle and its tangent, and so on, *in infinitum.*

Here, he remarks: "Reason seems to be thrown into a kind of amazement. . . . She sees a full light which illuminates certain places, but that light borders upon the most profound darkness." He continues:

> The absurdity of these bold determinations of the abstract sciences seems to become, if possible, still more palpable with regard to time than extension. An infinite number of real parts of time, passing in succession, and exhausted one after another, appears so evident a contradiction, that no man, one should think, whose judgment is not corrupted, instead of being improved, by the sciences, would ever be able to admit of it. . . . Nothing can be more sceptical, or more full of doubt and hesitation, than this scepticism itself, which arises from some of the paradoxical conclusions of geometry or the science of quantity. It seems to me not impossible to avoid these absurdities and contradictions, if it be admitted that there is no such thing as abstract or general ideas, properly speaking; but that all general ideas are, in reality, particular ones, attached to a general term, which recalls, upon occasion, other particular ones, that resemble, in certain circumstances, the idea present to the mind. . . . All the ideas of quantity, upon which mathematicians reason, are (if this be admitted) nothing but particular, and such as are suggested by the senses and imagination, and consequently, cannot be infinitely divisible. It is sufficient to have dropped this hint at present, without prosecuting it farther.

Let one suppose that every unit-particle is a perfect sphere, solid, inelastic, and smooth, the least practical of

building blocks to be used in the foundation of a house. Who could ever build any substantial structure on these rolling spheres? The physicist has never been able to see with his eyes these supposedly rotund little particles which, in aggregation, compose even the solidest block of granite. He looks at large aggregations, not at the innumerable particulars which give the largeness its reality. So he asserts that whereas houses may be built securely on solid cubes, it would be impracticable to build them on granite spheres that will roll.

Now, Kant accepts just such a general principle as though surely correct throughout, and then dissects it. He subdivides the granite block in thought until he obtains pieces so minute that they are mere specks, points of extension, either round or square as you choose to view them, objects as easily rolled as the most perfect sphere. "Ah!" we can imagine him saying, "Reason proves that in this granite block there is no ultimate principle of stability. The large stone is composed of specks separated in space, and each speck will easily roll. How can there be both stability and instability in an object which in gross is cubical, and yet which, when subdivided, is found to be movable throughout? The stone that somehow appears to be stable cannot be real! It is but a mental fabrication. It is a seeming materialism only—not a real one—about which we can never really know even that it exists, for our reasoning about it has proved it stable and unstable at the same time."

The physicist was wrong, however, in his principle of stability; and it should never have been accepted. Houses can be built stably on spheres even when the spheres do not touch one another. Indeed, every house is so built. Why? Because there are other principles reflecting the very power of mentality in its associations with matter, principles of transformations and of concentrating motions. Consolidating movements of matter-particles hold the minute spheres of the granite in snug structures, in dependable formations of equilibrium,—even as solid materials appropriate for foundations. Let us assert this, and then explain it.

Our reasoning will then ask this question: how could

concentrating pressures continue forever without accomplishment? Some of the spheres within the body must be transformed, we claim, and matter must change into non-matter so that there may be a fulfilled mental purpose for the mental restriction of the space that particles may occupy. If this occurs, some of the incoming particles will take the places left vacant by those which have been transformed. Concentrating movements will continue, therefore, but the transformations will be so invisible and so little understood that they will be denied, and the cohesive concentration will be otherwise explained. Nevertheless, this force inducing the general concentration, however it may be regarded, forever maintains the stability of the spheres composing this granite block.

Unless this is our belief, how shall we explain in mental realms this growth of spirit in physical realms, these falling of bodies toward the earth, these so-called "spontaneous" radioactivities of elements into constantly simpler formations, and these restrained structures both of atoms and of solar systems—and everywhere to the universal bounds? In general, except for the transformation of matter and the concentration of the denser objects which follows here, and the dissipations of the smaller objects (always within limits) there, how can we possibly account for the physical world as it is, and the disruption of the more complex structures through radioactivity? And except for the unceasing and significant change caused by the unceasing and "absolute" activity, how can we account for the evolutionary growth of mind, and the continuing life-experiences? How otherwise can we explain the perpetual movements, and those blows from which man extracts his sensations, his growth, and his conscious existence?

If Conservation were real, and transformation unreal, Kant's reasoning would perhaps be sound, but the universe would then be dead. In it there could be no such life as Kant himself experienced. But if transformation is admitted (of which man's life is one perhaps insignificant and accidental illustration), then the phenomena surrounding us become reasonable and the shadowy paradoxes disappear.

Kant's hypothesis, and most of the mechanical axioms as well, seem to us to be erroneous in principle. The attempt to destroy part of a great philosophy with a few pages of general argument may seem presumptuous, but if his premise has collapsed nothing else need be considered. If the preceding chapters, which have attacked somewhat in detail the views of Time and Space upon which Kant built, have served to disclose a faulty beginning, they have invalidated every branch spreading from this trunk of error.

Let us now consider Time and Space from the view-point of another German, Arthur Schopenhauer. We shall again use the interpretation of Professor Royce. Schopenhauer said:

> But my deepest nature is so superior to space and time that, as we have just shown, space and time are in fact *in me,* in so far as they are my forms of seeing and knowing. . . . Only in space and time do we seem to be separate beings. Space and time form, as Schopenhauer says, the dividing principle of things. In an illusory way they seem to distinguish us all from one another; but abstract space and time, with all their manifold and illusory distinctions of places and moments, and the real world collapses into one immanent nature of things. Since my own deepest nature is beneath and behind the time form of the apparent world it follows that, in essential and deep sense, I am one with all that ever has been or that ever will be, either millions of ages ago or millions of ages to come. And as for space, there is no star so remote but that the same essential nature of things which is manifest in that star is also manifest in my own body. Space and time are, as Hindoos declared, the veil of Maya or Illusion, wherewith the hidden unity of things is covered, so that, through such illusion, the world appears manifold, although it is but one.[1]

We shall not attempt to treat further of Schopenhauer's doctrine, nor of Royce's, but it may be well to note the agreement of Royce with Kant that Space and Time are mental fabrications without separate realities. Professor Royce discourages (as did Kant) any attempt to deny the old doc-

[1] *Ibid.,* pp. 251–2.

trines, or to suggest new ones. He says, in fact, that "The time is long past when really intelligent thinkers sought to do anything outside of intimate relations to the history of thought."

All original discovery or new theory is impossible, he thinks. The old ideas may never be reversed, or even revised fundamentally; they may only be amplified, or perhaps associated more perfectly, and then only when properly understood by means of careful historical study. New knowledge is at an end; no condition can ever arise that will display a new wave-formation on the shores of reason. Speaking of some lonely student advancing a new theory, Professor Royce says: "What they give you is always an old doctrine, more or less disguised in a poorly novel terminology, and much worse thought out than it has already been thought out, time after time, in the history of speculation." [1]

After this discouraging prophecy about future thinking how can anyone have the audacity to proceed with a new theory? Yet, if one were satisfied with the present-day position either in science or philosophy he would be pessimist indeed! The metaphysical philosophers, of whom Professor Royce was one, failed to realize that in making a choice of premise from many possibilities they could not be sure that the one chosen was completely real. One may think that he is selecting a rigid principle of truth but he is apt to be mistaken, first, because choice is possible only because the mechanical possibilities of any moment (by being creations of Will) are *more than one;* secondly, because minds are imperfect; and lastly, because no mechanical reality remains fixedly real or true for long in this changing world. The argument based on the concept of some necessary and invariable mechanical fact is never permanent nor all-inclusive, hence an important part of reality is sure to be lacking in the philosophy found on such a premise. Each philosopher builds on that which at best is but a temporary and unfinished truth. On this account the philosophies (premised, as most of them are on faulty and rigid mechanistic postulates) conflict. Each is an elaborated dialect sure to be rejected ultimately. Each

[1] *Ibid.*, p. 343.

is an imperfect word-and-reason structure erected on a bit of crumbling principle.

No philosophy built high upon the premise that mechanical Conservation is necessary even within the bounds of the pool of matter, can be final for its foundation is impermanent. Soon such a base will disintegrate and yield, and at last the unstable tower will crash down. None should claim infallibility and permanency for these structures. Evolution quickly develops a crater in that place where the foolish one, confident because unperceiving, has selected the solider granite because of its seeming solidity—as if it would be forever a permanent support. Unless every building is to topple the universe of mind, not of matter, must be its foundation. No part should be supported by physical characters for time will finally eliminate all substance. The edifice must be entirely mental if it is to remain permanently real.

There remains dependable, then, only these resources, subjects, interesting truths: the hypotheses of Evolution, and of the Power expressing its Purpose in creating Evolution. We can rely permanently only on the principles and results disclosed by the transformation of matter into mind. Conduct must correspond with the changing physical conditions if it is to remain harmonious and serene; and critical thought must trace out the rules and principles of Change. Science, too, must embody Change in its laws.

We must consider carefully the principles associated with Evolution, then, if we wish to attain concepts of permanent value. No other truths are intimate with the problems of changing life; no others have final reality. Evolution alone refers to new events, to significant occurrences, to the flow of life as it is affected and created by the altering environment. And since Evolution is related to both matter and mind, and since it has to do with the intimate passage of one into the other, and to the association between them as one reaches the other, it is understandable by thought, and is a proper field for rational study. A theory based upon Evolution does not develop contradictions, but dissolves them. As Professor Dewey says:

> Science is after all an art, a matter of perfected skill in conducting inquiry . . . those who are not directly engaged in the use of this art readily take science to be something finished, absolute in itself, instead of the result of a certain technique. Consequently 'scientific' philosophies have over and over again made the science of their own day the premises of philosophy only to have them undermined by later science. [1]

Again: ". . . systems which set out from things said to be ultimate and simple have always worked with loaded dice; their premises have been framed to yield desired conclusions." [2] And still again: "Perhaps it is a caricature to say that the ultimate of reason is held to be ability to behold nature as a complete mechanism which generates and sustains the beholding of the mechanism, but the caricature is not wilful." [3]

Professor Dewey questions the supposedly stabilized world of the mechanist in which experiences are assumed to average the same forever. He does not believe in the theories of Kant, Aristotle, Hegel, or Spinoza. "A purely stable world," he says, "permits of no illusions, but neither is it clothed with ideals. It just exists. To be good is to be better than; and there can be no better except where there is shock and discord combined with enough assured order to make attainment of harmony possible." [4] "In a world where everything is complete, nothing requires anything for its completion." [5] The truth of the matter surely is that "A thing . . . will crumble before the gnawing tooth of time. Every existence is an event. . . . The rate of change of some things is so slow, or is so rhythmic, that these changes have all the advantages of stability in dealing with more transitory and irregular happenings—if we know enough." [6]

In that last statement is concentrated truth. We could readily recognize Change, its reality, and its influence, if only

[1] Professor John Dewey: *Experience and Nature*, p. 3.
[2] *Ibid.*, p. 14.
[3] *Ibid.*, p. 58.
[4] *Ibid.*, p. 62.
[5] *Ibid.*, p. 64.
[6] *Ibid.*, p. 71.

we "knew enough." As things are, however, we are apt to observe only the rhythmic waves, and not the cause of their reversed motions nor the flow of the stream. It is this failure to recognize a Cause productive of restricted motions, and of Evolution, and to accept its influences, that makes our philosophies of materialistic permanencies impracticable and meaningless. This invalidates the philosophy of Kant, and accounts for a measure of inaccuracy in the laws of Newton. "A thing 'absolutely' stable," says Professor Dewey, "and unchangeable would be out of the range of the principle of action and reaction, of resistance and leverage as well as friction." [1]

And he remarks:

> Whatever influences the changes of other things is itself changed. The idea of an activity proceeding only in one direction, of an unmoved mover, is a survival of Greek physics. It has been banished from science [has it quite?] but remains to haunt philosophy. [2]

Professor Dewey here discloses the weakness of Kant and also of the monistic materialists. No philosophy of fixed or rigid principles, realities, relationships, or experiences, can possibly be valid in a universe the life-organisms of which (and the substances of which, as well) experience existence merely because a cause of absolute motions and differences affects both their environments and bodies. For a philosophy to hold an expectation of validity it must be predicated upon the assumption of a state of affairs that can embrace Change, and upon the laws—if there are any that may be counted on for the future—which Change follows. As Professor Dewey indirectly proves, all philosophies based upon mechanical reaction equalling action are hopelessly in error. Evolving change within a pool of restricted motions is the undeniable fact in this universe, and its reality invalidates every philosophy and mathematics that does not introduce the theory and the rate of change into its syllogisms and equations. The progress of human beings might even now be

[1] *Ibid.*, p. 71.
[2] *Ibid.*, pp. 73–74.

at an end, and the species might suffer complete extinction to-morrow, yet the Evolution of matter would still proceed.

Herbert Spencer believed in a circumscribed and balanced type of change. Although he did not realize this fact, his type of evolution (movements without dissipations) could obtain *only if constantly created by a Cause superior to mechanics.* His theory did not overcome the perplexities it involved. He seemed to think that the apparent uni-directional change really attained only the dignity of a universal equilibrium, or harmony of adjustment between things. He thought there might be one harmony between the material parts of the universe and another within its mental aspects.

Spencer did not regard the processes of the universe as indicative of, or as measuring and accounting for, the evolution of matter. He did not think that Change embraced the transformation of physical substance into spiritual essence. He did not believe that the motions of matter were created, limited, and reversed by an "absolute" power. Had Spencer taken a different view of reality he might have synthesized his beliefs and dissipated his mysteries. Like Kant, however, he regarded extension as a permanent and rigid attribute of the matter-particle—such a stable and fixed character, indeed, that it could be subdivided forever without disclosing new—even immaterial—qualities. Again, like Kant, he theorized concerning this infinite subdivision. In concluding his argument from this unsound premise, he said: ". . . We find no limit to sub-division until we arrive at the conception of centres of force without any extension." And again:

> Matter then, in its ultimate nature, is as absolutely incomprehensible as Space and Time. Frame what suppositions we may, we find tracing out their implications that they leave us nothing but a choice between opposite absurdities.[1]

It is strange that while this great thinker observed his universe seething with motion, life, significance, and variations, he should have disregarded the fact that in such a

[1] Herbert Spencer: *First Principles,* p. 52.

world this motion (as source of the life-experiences) could be reasonable only if there were a steady Change of one arrangement into another—the primal arrangement possessing the power even to cause the motion that resulted in the transformation.

Had Spencer perceived the part taken in his universe by transforming Evolution he would have perceived the absurdity of supposing that the unit of matter could be divided even once and remain matter. With a different perception he would have discovered in *transformation* the cause of growth, and of life. Carrying the conception further, and attributing to the power enforcing change its proper influences in material as well as in mental realms, he might have recognized in it the cause of the general restraints, and of the so-called "cohesions" into structures of matter-particles. He might even have been led to add change to the laws of Newton, and thus to charge them with a measure of relativity founded on an acceptable premise.

Instead, Spencer, for other reasons, claimed that the Kantian theory of Space and Time was absurd. He did not so conclude because he thought Kant in error in his supposition that matter was changeless. He did not attack the false premise of Kant but criticized his conclusions. He said of Kant's theory:—

> And the direct testimony of consciousness is, that Time and Space are not within, but without the mind; and so absolutely independent of it that they cannot be conceived to become non-existent, even were the mind to become non-existent. Besides being positively unthinkable in what it tacitly denies, the theory of Kant is equally unthinkable in what it openly affirms . . . the hypothesis carries in itself the proof of its own inconceivableness. For if Space and Time are forms of thought, they can never be thought of; since it is impossible for anything to be at once the form of thought and the matter of thought. That Space and Time are objects of consciousness, Kant emphatically asserts by saying that it is impossible to suppress the consciousness of them. How, then, if they are objects of consciousness, can they at the same time be conditions of consciousness? If Space and

> Time are the conditions under which we think, then when we think of Space and Time themselves, our thoughts must be unconditioned; and if there can thus be unconditioned thoughts, what becomes of the theory?[1]

Spencer thereupon dogmatically asserted that "It results therefore that Space and Time are wholly incomprehensible." He was as positive that nothing could be known of reality as Royce was certain that everything was known that could ever be learned, that Kant had sounded the depths, and that little else but a synthesis of knowledge remained.

Spencer proceeded with his category of the forever unknowable, and stated that the idea of absolute motion held another insoluble mental difficulty. This paradox arose like Kant's, from his limited and incorrect conception of space. He said:—

> Motion as taking place apart from those limitations of space which we habitually associate with it, is totally unthinkable. For motion is change of place; but in unlimited space change of place is inconceivable, because place itself is inconceivable. Place can be conceived only by reference to the other places; and in the absence of objects dispersed through space, a place could be conceived only in relation to the limits of space; whence it follows that in unlimited space place cannot be conceived —all places must be equidistant from boundaries that do not exist. Thus while we are obliged to think that there is an absolute motion, we find absolute motion incomprehensible.[2]

The incomprehensibility of absolute motion vanishes[3] when one conceives that the universe consists of a limited quantity

[1] *Ibid.*, pp. 47–8.

[2] *Ibid.*, p. 54.

[3] The arguments of Zeno, the Greek (about 500 B.C.), in his attempts to prove that our conception of motion led to insoluble paradox, are more formidable. According to him our *idea* of motion is irrational, because observed motion must necessarily pass through a finite space, and finite space may be subdivided into an infinite number of portions. But, since finite time is required for an object to move from one portion of space to another, an infinite time would be consumed in traversing the infinite number of portions composing the finite space under observation. For this reason it would appear that motion through any finite space is impossible.

The horse cannot reach the end of the race-track, for the course is divisible into an infinite number of finite portions as through the process of repeated

of matter; that Extension and Space are realities only as they refer to matter-particles such as they are, and when they are moving; and, lastly, when it is remembered that the motions given matter by mental powers are balanced in respect of the centre of physical energy, and that this centre of energy remains fixed. When related to this fixed centre, all motions are real, comprehensible, and "absolute." And only where substance is, do extension- and time-attributes have sway.

These are definite and comprehensible ideas, and, having them, we are able to see purposed and "absolute" motion in

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halvings. The course, like the mathematical series ½, ¼, ⅛, has an infinite number of possible terms, each finite, yet in summation not exceeding the finite length of the course. Other paradoxes are involved in the concept of motion. An arrow in flight must really be at rest, for otherwise, it could not be where it was at any one instant. Also, swift Achilles, starting in the rear of the slow tortoise, cannot overtake it, for when Achilles has reached the spot where the tortoise was when Achilles started to run, the tortoise itself has meanwhile gone on ahead, and the process of attempting to overtake will have to be repeated. This will continue indefinitely.

The arguments against the possibility of motion, according to our account of it (that is in terms of numbers of units of space traversed in a certain time), may be answered in more than one way. Nor is it necessary, as some have supposed, to assume that the points of space and the instants of time are finite though composed of an infinite number of parts, and that points and instants are continuous in the sense that they overlap. If there was continuous over-laping there could be no ending, for if there was an end, the last term of the series would not be overlapped at one end. There can be no physical continuity for such continuity could not have an edge, for the edge would itself dissipate the idea of continuity.

In the first place, finite space cannot be divided into a number of equal portions that fail to answer to the mathematical and philosophical principle that the whole equals the addition (by number) of its parts. This rule applies even to our concept of an infinite number, or at least to any number approaching infinity as close as we choose to imagine. If we could have a concept of infinity, the rule would apply to it. If, therefore, the space of a single foot might be imagined as divided into an infinite number of equal portions, then, by the same condition, each portion must be of infinitesimal width, and this infinitesimal width according to our principle must be such that the sum of all of them (and the sum of all their properties as well),—and we mean by the "sum" the property of one of them multiplied by the number,—must equal the width of one foot. For this reason, the sum of the time-intervals consumed in traversing the series of portions equals the finite time attributed to the velocity in question —namely the ability to traverse one foot in a certain totality of finite time. The important principle is that the product of a supposedly infinite number by a supposedly infinitesimal quantity cannot be determined mathematically, but is to be determined *solely by the facts of the particular case.*. (The truth is that the idea of an infinitesimal physical quantity is itself unreal). Any finite amount of time or space may represent the product of an infinite number by an infinitesimal quantity-unity. If, therefore, one is willing to grant that it is sensible to assume that an object, or its property, is infinitely divisible, he must virtually admit in the same breath that the sum of the infinite number of parts composing it (or its properties) is finite—namely, that it represents the thing itself.

Zeno was thinking of the motion of a piece of matter, a visible object, through a void in the direction of some other piece of relatively stationary matter.

all motions—everywhere. Only the central point of all mass-movements may be regarded as stationary, and even this theoretical point, while unreal in itself, has meaning in that which it represents.

Spencer was not content to stop here. Consistent with his mistaken premise he next gave us his confused idea of the transfer of motion. He did not view the motion of matter as an expression of mental volition. He did not see here an illustration of intangible mental will-to-move added to particles, a something which, though real and significant,

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The motion of matter in reference to a void is indistinguishable. It cannot be formulated. Were the void moving with the piece of matter, the fact could not be determined by the sense-data. Such motion was therefore not in question. A feather blown by an invisible wind moves towards the house, but the sensation of sight refers only to the motion of the feather relative to the house. The fact, therefore, that to some persons it seems reasonable that a void should be regarded as divisible imaginatively into an infinite number of portions, has no significance when referred to the number-tags conventionally used for formulating the motion of one physical object relative to another, as here being considered.

If the unit of physical matter is finite, it has an extension occupying not an infinitesimal but a finite extension of space, and the unit of physical space which is entitled to the number-tag of "one" (1) for use in formulating its physical relationships (whether static or changing) cannot be less than the space-extension of this unit of matter. And such a formulation is being used when the statement is made that one object is moving relative to another at a velocity of five feet a second. In a proper number-system for use in physics, therefore, and when there is a correct numerical description of the velocity of motion in terms of true physical properties, the space separating any two objects cannot be regarded as properly representable by an infinite number-series. Indeed, it cannot properly be represented by more numbers than that addition of numerals which will account for the number of the physical units of matter, which, when placed end to end in contact, would fill the space between the two objects in question, along the direction-line in question.

Numbers as applied to imaginary portions of an abstract void have no place in a discussion involving the relative motions of physical objects, and the introduction of irrational numbers (in their physical aspect) for a use in physics is bound to bring in paradoxical concepts. The actual velocity in terms of physical space and time, of one object towards another, is determined by experience, and the results of this experience can properly be represented by a statement (or formula) of velocity in terms of numbers only when the number-tags have been properly chosen in reference to physical properties. The velocity-formula has been numbered to subscribe to the experience. When we say that a ball is moving with a velocity of five feet a second we mean that experience has proved this to be fact that can properly be presented (for a certain amount of motion in a finite space) by these number-tags. The velocity in question is actually entitled to this enumeration as a traverser of this amount of physically measured space in a second. Indeed, the knowledge *of* motion, the knowledge that we must possess of the physical world before we can commence to formulate motion, is possible to us only because there is the motion of light-rays from physical objects through finite space to our eyes. Unless there were this motion, we could not even begin the argument about the fact that such motion is impossible. A proper concept of the physical meaning of numbers as properly used (see chapters XVI and XVII) should make this whole subect clear.

came entirely from non-material realms, and which is passed on from one piece of matter to another without affect on the physical qualities of inertia and solidity of that particle which receives or surrenders the motion. He did not see that this expression of will could not be subjected to material definition or reference. He did not conceive that motion was real in a spiritual sense but no reality in a material sense. Instead, he regarded motion as something which might be subdivided indefinitely like grains of dust. This is what he said:

> Here is an object at rest and here is the same object moving. In the one state it has no tendency to change its place; but in the other it is obliged at each instant to assume a new position. What is it which will forever go on producing this effect without being exhausted? And how does it dwell in the object? The motion you say has been communicated. But how? What has been communicated? The striking body has not transferred a *thing* to the body struck; and it is equally out of the question to say that it has transferred an *attribute*. What then has it transferred?[1]

The "charge" of the "will-to-move" is not a *thing,* nor is it an *attribute* of a thing. It is a quality which possesses no inertia, no solidity, no tangibleness. It makes no use of space or time. It has no relation to the physical definition. It is no less than an expression of *mental power itself*. It is that same something which made Spencer real to himself, which made him mental, vital, spiritual, and enabled him to move his body. The mind and its powers are one, hence the mind cannot view the motion of matter as anything material, exterior, or separate. The subjective, motion-giving attribute of mind and the objective inertness of matter are the two principal characters in the universe, and because Spencer failed to define them clearly he became involved in paradox. He failed, too, to note the purpose which is revealed in the unceasing cyclical motions and the evolutionary transformations resulting therefrom. Had he even recognized the separate elements of matter as different groupings, and with dif-

[1] *Ibid.*, p. 54.

ferent attributes which last only for a time, he would not have become so confused as to assert that a better understanding of motion could never be had.

Spencer next observed acceleration; and again the never failing dilemma appeared—a contradiction always to be expected when the premise is unreal. The same perplexity had arisen when he considered the collision of two solid bodies. He was unable to see how any body could possibly acquire velocity without passing through all intermediate speeds, and this last idea appeared to him to be entirely incomprehensible. He said of a body subjected to forces that changed its velocity:

> It is quite possible to think of its motion as diminishing insensibly until it becomes infinitesimal; and many will think equally possible to pass in thought from infinitesimal motion to no motion. But this is an error. . . . Halve and again halve the rate of movement forever, yet movement still exists, and the smallest movement is separated by an impassable gap from no movement. . . . These, equally with the foregoing, show us that though we are obliged to think of such changes as actually occurring, their occurrence cannot be realized.
>
> Thus neither when considered in connection with Space nor when considered in connection with Matter, nor when considered in connection with Rest, do we find that Motion is truly cognizable. All efforts to understand its essential nature do but bring us to alternative impossibilities of thought.[1]

But why? If the unit particle of matter is of definite size, if it cannot be subdivided except that it ceases to be matter, and if acceleration is never added except through the blows of unit-particles, where then is the difficulty? For any certain velocity of the unit-striker there is no infinitesimally small acceleration in the one which is struck. Indeed, there is no straight-line acceleration possible to a striking body moving at a certain speed that is less than that added by the blow of one of the units of matter composing the striking body; and this acceleration when given by a unit of matter

[1] *Ibid.*, p. 55.

moving at typical speed (which is the measure of the unit of energy), is the unit of *all* straight-line acceleration. Had Spencer conceived that the unit-particle was transformed when subdivided, and also that the motion of the unit-particle afforded us our smallest amount of mechanical energy and of acceleration, these difficulties, too, would have vanished. What he would then have observed would have seemed logical, for it would have proved consistent with the phenomena of motions and changes everywhere to be observed. Posit evolutionary transformation, and the ideas of continuous acceleration, as well as the paradoxes and contradictions flowing from it, disappear as if by magic.

Still other incomprehensibilities vanish when subjected to the test of this evolutionary hypothesis. In discussing the relationship of matter with force, Spencer assumed that the laws of attraction at a distance were validly founded, and, believing this, he found the usual measure of unreality.

In speaking of gravitation he said:—

> . . . the hypothesis of Newton, equally with that of Boscovich, is open to the charge that it supposes one thing to act upon another through a space which is absolutely empty—a supposition which cannot be represented in thought . . . it is impossible to conceive motion in the absence of something moved. Similarly in the case of gravitation. Newton described himself as unable to think that the attraction of one body for another at a distance could be exerted in the absence of an intervening medium. . . . We are obliged to conclude that matter, whether ponderable or imponderable, and whether aggregated or in its hypothetical units, acts upon matter through absolutely vacant space; and yet this conclusion is positively unthinkable.[1]
>
> If, on the one hand, we cannot in thought see matter acting upon matter through a vast interval of space which is absolutely void—on the other hand, that the gravitation of one particle of matter toward another and toward all others should be absolutely the same whether the intervening space is filled with matter or not is incomprehensible.[2]

[1] *Ibid.*, pp. 56–7
[2] *Ibid.*, pp. 57–8.

Spencer usefully emphasized the contradictions in the current theories of Space, Time, and Force. He pointed out clearly enough the mental insufficiency of the knowledge which the world accepted; but with this exposition he stopped. He thought there was nothing further to be done—that a permanent wall was built in front of mental comprehension of the universe. Yet these contradictions and paradoxes are not inevitable, but man-made; they are the natural outgrowths of theories built on incorrect assumptions of fundamental facts. They are theories erected on the doctrine of Conservation—that false premise of stability and changelessness in a universe which shows not one conclusive evidence of such insignificance. They are theories which virtually deny the presence and power of that Cause in whom so many of these scientists believed in spite of the implications of their science.

Spencer did not perceive the absurdity of accepting definitions and principles of matter and motion on the baseless supposition that the amount of matter and motion remain forever the same. He did not perceive that absolute Change *does* pervade the universe, and that in it there is no perfectly compensated cycle. He did not realize that nothing but this absolute Change is really important. He should have seen also that the very fact of Transformation proves the presence of two characters one of which is composed of an arrangement of parts of the other so that by a change of this arrangement one can become the other. Had Spencer achieved this viewpoint his perplexities would have dissolved, and he would never have asserted that the way to knowledge of the secondary material characters was for ever blocked.

Spencer said truly that Kant's ideas are incomprehensible. He made the same statement, however, with regard to "attractions at a distance," and yet in the latter case he was willing to admit the reality of these inconceivable forces. With the same concession he might have admitted the correctness of Kant's hypothesis.

Our viewpoint is different. We have otherwise approached the subject. We have suggested a new principle that

should be added to our idea of reality, and have found then that the Kantian premise contains an inaccuracy sufficient to invalidate any reasoning built upon it. We purpose to treat the present theory of gravitation in the same manner.

As Spencer said, the idea of "attraction at a distance" is incomprehensible. Must we accept it, then, as real, and say that understanding is here forever blocked? Or shall we, instead, contemplate our universe with evolutionary tendencies in it, with a mental power in it, with purpose in it, with the power and volition to move matter in it, with almost everything but true mechanical Conservation in it, and inquire whether the present theory of the cause of certain measures of concentration does not give place to a more consistent hypothesis?

In discussing the perplexities of Spencer we have been encouraged to discover that our different concept has cleared away some of his difficulties, and has adjusted some of his confusions. The different theory has here given proof of its validity. It remains to be discovered whether a new and more reasonable theory of gravitation may be had.

And what of the mechanical formulas grounded upon the theory of Conservation and upon experiences with large bodies for short intervals? If Conservation is incorrect, if evolutionary transformation *does* destroy some substance, if a mental Power moves and then restrains matter within bounds in order to accomplish Evolution, then the mechanical formulas lacking these principles are only *relatively* accurate. A relativity doctrine appears here which is based upon what appears to be reasonable, and which, therefore, *is* comprehensible, and which must be introduced into mecanics even though Time is not changed by relative motion, as Professor Einstein claims. We shall perhaps escape, after all, the necessity of admitting the mysterious hypotheses of Einstein, for we seem to have discovered more reasonable grounds for perhaps that very measure of relativity in the mechanical formulas which has been proved to exist.

CHAPTER XIV

CONVENTIONAL THEORY OF ATOMIC STRUCTURE

> Though he makes his body, he denies that he makes it;
> Though the world exist from thought, thought is daunted
> in the presence of Truth.
>
> EMERSON.

WHAT has been said of the relations of mind with matter will doubtless be unacceptable to many as proof of the inexactness of the Conservation theory. The analogies will not convince the empirical physicists. Unwilling to accept the intangible, or at least the unformulable, they will say, "We do not understand how the mind moves the body. It may even be possible that the usual mechanical rules do not apply exactly to this phenomenon, yet we conclude that mind-power has a mechanical origin and nature. This is our judgment after having traced the evolution of the mind from the original amœba to man. We do not believe that action of something as intangible as a general mental power of non-material definition is connected with the radioactivity of uranium. Any change that there may be in one irreversible direction is like that to be seen in the running down of a clock; it corresponds with the second law of thermodynamics. Evolution may even thus be accounted for. It may be a phenomenon perhaps in one sense, outside of traditional mechanics—but that is all. We are sure that the motions of matter are not being destroyed or re-created by an independent power. Present movements are derived solely from earlier motions. A Creative Cause may have started the motion in past ages, but, since this beginning, there has been a purely mechanical sequence of events, all corresponding to the Conservation principle." This is the conventional view. Only a few scientists depart from it.

While most physicists of the nineteenth century denied that human mental powers could alter the motions of substances in a way transcending pure mechanism, in more recent years advanced thinkers of another school have reached a somewhat different conclusion. A distinguished Englishman, Dr. J. S. Haldane, in his book entitled *Mechanism, Life and Personality,* presents a rather typical modern opinion —a belief formed after having taken into consideration the latest knowledge of the physiology of human beings. He writes:

> Although the mechanical theory of life will soon become a matter of past history, there can be no doubt that it has filled an extremely valuable part in the development of physiology.'' (p. 61) The mechanistic theory of heredity is not merely unproven, it is impossible. It involves such absurdities that no intelligent person who has thoroughly realized its meaning and implications can continue to hold it. (p. 58)

These are rather strong statements, but Dr. Haldane continues:—

> It was only through the prevailing ignorance of physiological facts that the physiologists of the middle of last century imagined that they were approaching a physico-chemical solution of elementary physiological problems. To us Schwann's theory of cell-growth seems almost as crude as Descartes' extraordinary theory of the mechanism of growth and development. p. (46) Sooner or later, however, it will be realized that the materialism of the nineteenth century has been nothing but an insignificant eddy in the stream of human progress. (p. 73) [Bodily processes] are only phases of the organic determination which is the key to all the phenomena of life. (p. 87) [And again]: The details of bodily structure must likewise be interpreted as the expression of organic determination. (p. 84)

More and more this vitalistic theory of life is accepted by those who are not classical physicists, and yet it virtually postulates the active presence of a Cause which may be per-

sonified into the likeness of an active Creator. This view is held more and more by those who look beyond the rut of the inaccurately founded physical laws and who are able to perceive the Power which now creates the routine of the rut and the measure of truth in the average of its statistics. The inflexible empirical physicists of the old school, and the pure mechanists, still believe, however, that the universe is a self-running machine, yet this view is denied by the very fact that persons who presuppose that the universe is mechanically determined, are quickly met with perplexing riddles.

Mechanics, of itself, appreciates nothing and charts nothing. Nor do tables of statistics of composite events interpret the meanings of life. Imagination, the use of deductive and inductive reasoning, the intuition for the principle that may be drawn from a customary sequence of events, and the will to investigate, all these are required to solve the larger problems, and all refer to spiritual rather than to mechanical characters. The greatest scientists have been great imaginers, but, even so, the scientific mysteries described by Herbert Spencer are still mysterious. The biologists to-day cannot explain the mutations of species; the physicists, by means of the highly imaginative conception of Professor Einstein (a statement of reality perhaps made more satisfactory to the physicists because it may be expressed in terms of higher mathematics), have only recently been able to throw some of the mechanical mysteries so far into the depths that, to some, they seem to disappear; and economists, with their fixed laws relating to only one side of the reality of man's life, have been unable thereby to improve much the standard of average living.

The idealism which infers that spiritual forces operate potently in mechanical realms has had so little influence upon scientific opinion that is seems useless to repeat its *credo*. If one wishes to convince, he must offer a theory that explains mechanical phenomena now unexplained. As Professor Einstein seems to have advanced the only explanation which, if sound, would perhaps permit the Conservation theory to be regarded as tenable in some of the wider rela-

tions of world with world, and perhaps appropriate for a finite universe, I am forced to consider, not his mathematics (for I am incapable of this), but the philosophical aspects of his theory. I must at least trace some of the implications of his deductions.

There are scientific mysteries, however, in addition to these developed from consideration of the passage of light-rays between worlds. Happenings equally inexplicable take place within the atoms of matter composing our elements—in realms where the hypotheses of Professor Einstein do not appear to apply. Explanations of the nature of light, gravitation, and electricity must be sought in the relations of the inconceivably small, in realms not subject to exact empirical experience. It will be wise, then, to give a short outline of one of the modern theories of atomic structure. By knowing a little of that which is assumed to take place within the atom, and of events which cannot be explained in harmony with Conservation, we may find support for a theory denying this foundational basis of mechanism. It should be stated, however, that ideas of the internal structure of atoms are constantly being revised. New hypotheses are suggested principally because they seem better to explain events, but no theory has yet explained all of them. The Bohr atom, a concept of Neils Bohr (not really a concept, perhaps, but more of a working hypothesis frankly based on bold and unsupported assumptions), is described here; but recently some have preferred the view of Schrödinger that the atom is a continuum in which electric charges, for some unknown reason, pulse from place to place, emitting energy-waves. This most modern development of wave-mechanics does not hold very much promise, however, as Sir James Jeans admits.

The spaces between the atomic parts are so tiny that the human eye cannot see into them even with the aid of the most powerful magnifying lenses. Hence, their structural arrangement has been interpreted indirectly, and chiefly by means of the spectrum. We observe the weight, speed, and deflection of the projectile from an atom, and then attempt to describe the realities of the hidden weapon and force

which discharge it. According to the Bohr suggestions, the atom is an electromagnetic structure. An element like iron is assumed to be composed of a definite number of the simplest of all atoms (hydrogen atoms), and there is supposed to be a central nucleus in each atom charged with, or composed of, electricity. About this nucleus planetary electrons revolve—electrons which, when released from the atomic structure, in some way constitute negative electricity.

The atoms of all the elements are composed of aggregations of the hydrogen atom. An atom of iron is equal in weight to twenty-six hydrogen atoms and is supposed to be composed of twenty-six hydrogen-atom-nuclei each of which supplies the "attractive" power that holds one electron near itself as a planet. The structure of the more complex atom depends upon the number of hydrogen atoms composing its nucleus, but the atomic structure of each element has consistently the same mass. Thus the twenty-six hydrogen-nuclei of iron assume a definite central structure, and the twenty-six planets, when in balanced energy-relationships, assume characteristic orbital positions. The atoms of the different elements vary also in the arrangement of the hyrogen-nuclei composing the central nucleus, but it is supposed that each hydrogen-nucleus, when in electrical balance, is associated with one planetary electron. These planets of the complex atoms move separately in symmetrical orbits around the composite nucleus, each in its proper place.

The difference between the atoms of two such elements as copper and iron is to be discovered principally in the different numbers of "positively charged" hydrogen-nuclei in their central suns. This difference may also be measured, however, as a relation of the number of planetary electrons normally revolving about the central nucleus. The larger the central nucleus, the more hydrogen-nuclei it will contain, the more mass it will have, the more "attraction" it will exert, the more planetary electrons it will hold near to itself, and the more complex its planetary arrangement will be. All planetary electrons have the same mass, yet it is assumed that they revolve at different distances from the nucleus. Elements are supposed to differ basically, then, in the structures of their

atoms, though all are composed of the same building-blocks.

The atom of iron is supposed to be in perfect electrical balance when it has twenty-six planetary electrons. If, however, some of the planets should leave the structure the atom will still be called "iron," but its perfection of electrical balance will be destroyed, it is said, and the atom will then be described as "charged" with positive electricity. The electrical equilibrium of the atom can be restored only by the return to the structure of the same amount of matter that previously departed. It is assumed that the structure displays both the willingness and the ability to accept these planetary parts back. This willingness is similar to that which vacuum conventionally expresses towards matter. Whether or not this is assumed to be a volitional or a mechanical force, it is quite opposed to that which permitted (or caused) the electrons to leave the structure.

A hydrogen-nucleus is supposed to be "charged" with unsatisfied positive electricity whenever it fails to have one planetary electron under its direct attractive influence—that is, as a part of its permanent, or satisfied, structure. This "charge" of positive electricity is supposed (erroneously, we believe) to be derived from the uncompensated "attractive" force displayed by the "proton", or hydrogen-nucleus. A "proton" is supposed, in one sense, to be the unsatisfied unit of positive electricity just as the electron is the unsatisfied unit of negative electricity, and the proton is called "positive" principally because a name must be given to that which "attracts" the negative electron. There is always an excess of one "proton" in (or constituting) the nucleus of a hydrogen atom,—at least so the scientists suggest,—and they assume also that the nucleus consists of this one unit of positive electric charge chiefly because they believe that this hydrogen-nucleus always "attracts" to itself one exterior planet of negative electricity. The single electron, the planet supposed to revolve about the nucleus, is a piece of matter that can be isolated and measured by its effect when striking other particles of matter, and a stream of these electrons, when passing through a wire away from their source, is known as negative electricity. The nucleus of a hydrogen atom and its

single electron are supposed to revolve around each other like the ends of a dumbbell.

The structures of the larger atoms are less simple. Carbon has six hydrogen-nuclei in its central sun, hence, according to the Bohr hypothesis, the nucleus of the carbon atom has a "charge" of six units of positive electricity that is satisfied by the presence of six planetary electrons. The mass of the atom of carbon is six times that of the atom of hydrogen. The atom of silver has forty-seven hydrogen-nuclei in its centre, and is supposed to have forty-seven associated electrons. Its mass is that of forty-seven hydrogen atoms. Lead has eighty-two hydrogen-nuclei and eighty-two planets; radium eighty-eight; and uranium ninety-two. No element has yet been discovered, of this earth or in the stars (by spectrum analysis), which has a larger or more complicated atom than uranium. Uranium, however, is "spontaneously" radioactive—that is, some of its parts are repeatedly leaving the central nucleus and shooting into space. There are many other radioactive atomic structures, but no atom exists which is not a simple multiple of the hydrogen atom.

In the more complicated atomic structures, the hydrogen-nuclei, or building-blocks of the central sun, arrange themselves as far as possible in groups of four, and, when radioactivity occurs, a group of four hydrogen-nuclei (with, however, only two associated planetary electrons) are usually expelled at one time. This grouping of four hydrogen-nuclei, when associated with only two electrons, is called an *alpha* particle. The alpha particle lacks two of the four electrons required to maintain electric balance. Why the alpha particle leaves the atom lacking two rather than four (or all) of its electrons, is a scientific mystery.

When the radium atom (with eighty-eight planets) decomposes, alpha particles are emitted from the central nucleus, but when this alpha particle encounters two free electrons in space, it accepts them as satellites, becomes satisfied it is said, and is then known as the atom of helium gas. The electrically satisfied helium nucleus (consisting of four protons) is always associated with four planetary electrons.

The alpha particle is the half-way stage between four grouped hydrogen-nuclei (without their planets) and a complete helium atom. Hence the nucleus of the alpha particles is only half-way satisfied electrically. When this alpha particle is expelled from the nucleus of an atom of radium a definite number (strangely enough) of the eighty-eight electrons revolving about the atomic nucleus are struck and carried off. When the radioactivity of an atom of radium has run its course there remains an excess of only eighty-two protons in the central nucleus, and there will then be only eighty-two planetary electrons associated with each nucleus (rather than the former eighty-eight), and the atom will then be an atom of lead.[1]

When an alpha particle shooting from an atom of radium strikes something head-on, it gives an impact 7,380 times as great as that of a single electron moving at the same speed. As the alpha particle is composed of four hydrogen-nuclei and two electrons, each hydrogen-nucleus delivers a blow about 1,845 times (one-fourth of 7,380) greater than that of a single electron. For this reason the mass of one hydrogen-nucleus (or proton of positive electric charge) is supposed to have approximately the mass of 1,845 electrons. Under such circumstances one would expect the hydrogen-nucleus of an atom to occupy a large volume as compared to that of a single electron. It is thought, however, that the volume of the proton is much less than that of any single isolated electron. If this be true, it seems to prove that neither the hydrogen-nucleus nor the electron is the smallest particle of matter.

According to the hypothesis, protons are "charged" with, or consist of, positive electricity, and electrons consist of negative electricity. Positive electricity is that which "attracts" negative electricity and negative electricity is that which "attracts" positive electricity. Negative electrons are supposed to repel one another, and positive protons repel one another. It seems strange that one electron should

[1] It should be noted that the radioactivity which occurs as the atoms of a mass change into lead adds billions of electrons and alpha particles to the energy of the exterior universe.

always be found moving as a flying planet in an orbit around the nucleus of the hydrogen atom. If the proton really "attracted" the electron sufficiently to hold it in a repeating orbit close by, one would think that occasionally this planet would get into the nucleus itself. Why should it not reach a point close to that which attracts it? Why do the nucleus and planet of the hydrogen atom remain forever separated? And why does the proton not attract a second electron into its influence? Science has no answer. And if an atom is in a perfect balance of attractions and repulsions when its planetary system is composed of a certain number of electrons, why is it that two separated atoms are "pulled" towards each other as wholes by another kind of attraction —even, perhaps, to the point that electrons are squeezed closer to electrons and protons closer to protons, and even though these parts are supposed to repel one another?

The Bohr hypothesis has many peculiar phases. The planetary electrons within the atoms are supposed to repulse one another although the different planets of the sun are supposed to attract one another. Similar types of planetary orbits of bodies composed of the same unit parts are thus assumed to be obtained from opposed principles. One (the atom) is formed in the face of the repulsion of the different planets of the system, and the other (the solar system) is able to persist while the different planets "attract" (rather than "repel") one another.

Bertrand Russell says: "An atom differs from the solar system by the fact that it is not gravitation that makes the electrons go around the nucleus, but electricity."[1] This statement attempts to distinguish between two attractive forces, gravitation and electricity. According to the usual interpretation, however, gravitation does not make the earth move in its orbit about the sun, but merely prevents it from flying off into space. According to the physicists, the earth's independent and inherited motion (in the average tangential, or in a direction perpendicular to a radius from the sun) gives it the possibility of an orbit. The electrons would not revolve around the nucleus unless they had previously re-

[1] Bertrand Russell: *A B C of Atoms*, p. 23.

ceived from some other source a tangential straight-line velocity in reference to the nucleus. The force-principle that makes them revolve is not electrical "attraction." The energy of a straight-line motion is *deflected* (and therefore reduced as a motion in this particular direction) by a force which may or may not be an electrical "attraction." Perhaps this so-called "attraction" *is* of the same general nature as gravitation; but it is also possible that neither gravitation nor electrical "attraction" represents force acting at a distance. Perhaps both are unrealized compulsions. Both may result from those unusual movements of masses which occur whenever the average state of energy-equilibrium of one volume with respect to another is unbalanced by Evolution.

And this return of electrons to their regular places in an atomic structure may itself be nothing more than the motion required to satisfy the principle of general energy-equilibrium. When a container is exhausted of air, a vacuum-principle is discovered within it which seems to exercise a force of "attraction" for the moving air-molecules outside. Yet the seeming "suction" of the vacuum is not a real "atttraction." The reduction in the resistance to motion in this direction permits (or, in a negative sense, "causes") the *already oscillating* air-molecules to move unusually towards the vacuum—or place of abnormally reduced resistance. A similar compulsion may "cause" two electrons (but only when they are already oscillating in the open spaces between the elements) to move unusually towards the vacuum (or place of less than the usual energy-demonstration) of an alpha particle. An alpha particle is a structure, we believe, which can receive the associated oscillatory motions (and, therefore, the energies) of two free electrons (and no more) without manifesting as a structure more than that amount of energy of motion in all directions that permits it as a structure to remain in a fairly balanced equilibrium of energy with its environment. The alpha particle can acquire (and then retain) the energies of two associated electrons without losing its normal cohesive symmetry, or balance of energy-expression, and without tending to break down structurally thereafter. Without the association of

the energies of two more electrons, the alpha particle may be described as exhibiting a vacuum for the associated energies of two electrons. Or, it might be loosely and incorrectly said then that the alpha particle has a "positive electric charge" towards electrons—and can "attract" two of them to itself from a distance.

If it is proper to assume that the open spaces contain electrons moving in all directions, we may also assume that the alpha particle, after being ejected from radium or uranium, will quickly garner from the environment the usual energy-influences (and the masses also) of two electrons. It will quickly become that which is called a satisfied atom of helium gas, a structure without "electric charge" and with no ability, either to "attract" additional electrons into its energy-volume-association, or to retain those that accidentally strike into its grouping. Likewise, if the helium atom should ever be deprived of its four associated planetary electrons it should then represent a structural formation that can receive (and also retain) four electrons. It will then represent a place of energy-harmony for this additional number of electrons. Obviously, then, the neighbouring and haphazardly moving electrons of the open spaces will exhibit what may be incorrectly described as an unbalanced measure of irreversible energy-expression (or "pull") towards this helium-nucleus.

When corpuscles (the bits of structure composing the mechanical fluid between elements, we believe) are out in the open spaces, they are hammered back and forth in all directions. They tend to move in straight-lines until deflected by collisions, just as do the molecules of all gases. These free corpuscles (perhaps electrons, or, more likely, the smaller parts composing the electron-structures) react from every blow except that sending them into the embrace of some atom which can accept them permanently as part of its normal energy-structure, and which can therefore hold them in energy-balance with the environment. When forming the part of such a grouping the particles will repeatedly oscillate back and forth within a limited volume in the neighbourhood of the nucleus of the atom, and this amount of matter

will, in the average, remain there in such perfect balance with the average energy-expression of the environment that it may be described as the "satisfied" part of a fairly permanent energy-volume—one that has no "electric charge," as it is then said. But, when the helium atom has the mass of four electrons constantly associated with its energy-volume, it cannot accept more planets as permanent parts of its energy-structure. It will then offer resistance to the abnormal approaches of additional electrons. When properly associated with moving electrons, its energy-volume will express towards all the other electrons of its immediate environment as much energy in the average as they express towards itself. On no other terms can its structural integrity be maintained.

This explanation of electrical "attraction" and "balance", as the reader will note, is unconventional. We do not assume that the planetary electrons are pulled (at a distance) by a positive charge of electrical attraction exerted by the atomic nucleus, but we believe that they are forced into this structural relationship by exterior blows. The energy-expression becomes perfectly balanced, in the average, only after this new relationship has been established. According to this view, the so-called "electric attraction" of the nucleus represents nothing more than the lack of the normal energy-expression of parts within a certain volume—a lack that will be compensated by the presence of additional moving parts. According to this theory, one can easily understand why each atomic nucleus exhibits that which is improperly called an "attraction" for a certain number of electrons—and for no more. When the atomic volume has become perfectly balanced by having associated in it that certain number of moving electrons that can be retained by it with energy-harmony, it is then neutral in its energy-relationship with its environment. It is no longer "negatively charged." Nor can it ever be given a *permanent "positive charge,"* for it cannot long retain any additional electrons that may happen to come into its volume.

Corpuscles move this way and that within and also outside of atomic structures. These motions are required to

fulfill the principle of universal energy-equilibrium. A certain number of oscillating particles will remain in fairly permanent association with certain structures, for these structures when thus subjected to their energy-influence will represent a perfect energy-harmony with the environment. At least the energy-balance will be so perfect that the structure will remain within one average volume for a long time. Movements in adjacent volumes maintain energy-balances within these volumes, and, after all necessary structural adjustments have been made, each form-structure will contain the number of parts (and will, therefore, have the average density) that it must have in order to subscribe to the principle of general energy-equilibrium. The associated corpuscles (electrons, perhaps) are nothing more than those particles which normally maintain the "cohesion" and energy-balance of an atomic nucleus.

This, then, is our explanation of atomic symmetry, and also our interpretation of that which is conventionally called an "electric charge." It conforms with our other views. According to this theory the motions developed by the so-called gravitational forces are in a different category from those induced by the so-called electrical attractions, for gravity acts to restore a balance destroyed by the permanent disappearance of substance whereas electricity is a movement to restore balance to some atomic structure abnormally unbalanced in its energy-manifestation by other mechanical forces. These explanations will be amplified in later pages. Here we are principally concerned with the conventional theory.

Mr. Russell does not describe "attraction" in detail. He remarks that electricity "is not a thing, like St. Paul's Cathedral; it is a way in which things behave" when they are electrified.

We are asked to understand that it is this "way in which things behave" that makes electrons revolve around nuclei and stay near protons and return to nuclei after having left the energy-balance of the atomic volume. Electricity is defined as electric behaviour, and electricity makes electrons revolve in orbits merely because we mean by an electron

that bit of matter which, when near a proton, will revolve in an orbit about the "positively" charged proton as an electron does. Why might we not say in the beginning that electrons oscillate in cycles in fairly permanent association with atomic nuclei for reasons that physicists have never given, and which perhaps they never will give so long as they ignore the existence of an external Creative Power as well as the nature of the average pressure-equilibrium which it maintains? Scientists will never explain gravitation, we believe, until they are willing to deny their doctrine of Conservation, and until they concede the presence of a significant Change in the mechanical history of the universe—a Change which stands for more than the equalizing of energy-potential and the reduction of the possibility of action that the theory of the steady increase of entropy calls for.

The motions of matter cannot be interpreted in terms of the theory that mechanical forces themselves create the unceasing movements of matter, and also supply the power that reverses the motions so as to limit boundaries. Attempt if you will, to explain in mechanical terms why or how a man moves his legs. Try to give mechanically determined explanations of this simple life-phenomenon and you will find yourself in the dilemma of the scientist who tries to show how an electron influenced by "attraction" revolves around the nucleus of an atom in repeating orbits. He cannot thus explain the reversed motions of mass, for such reversals require the continued use of real energy. Nor can such a scientist suggest where gravitational forces might originate, nor can he identify the source of that power from which his so-called electrical "attraction" is drawn.

We are presenting here only a few of the more important of the modern concepts of atomic relationships. Highly interesting descriptions of these phenomena are given in many books.[1] The treatment is fascinating. It is largely assumption, but that theory which is accepted (even temporarily) is possessed only because of the genius and imagination and faithful work of a few men. The physicist-artist (for we may

[1] We refer the reader to *Within the Atom*, by Mr. John Mills, and to *A. B. C. of Atoms*, by Mr. Bertrand Russell.

call this man of tremendous imagination an artist) who founded the general theory of the electromagnetic nature of matter and light, was the brilliant Englishman, Michael Faraday (1791-1867). To him and to his follower and disciple, Clerk-Maxwell (1831-1879), we principally owe our conception of the composition of the atom. The great German teacher, Helmholtz (1821-1894), and his pupil, Hertz (1857-1894), and later explorers and scientists, including Rutherford, Millikan, Planck, Roentgen, Crookes, Bohr, J. J. Thomson, and others, have given us much of our detailed information (and theory) about inter-atomic phenomena, and have developed those principles which have made possible our modern electrical industry, our telephones, and our radio-communication.

How much is known, marvellously much, about that which happens! Yet, what fundamental *principles* are really known? Great feats of imagination, much accidental discovery, and many observed experiences of various reactions from various combinations have informed us to some extent about *what* takes place, but we have not been told *why* it takes place. We know, for example, some of the laws of the movements of electrons but no one has identified this "it" that operates as electricity, and no one explains *why* it operates.

Electricity as used commercially is an energy-stream delivered by electrons—a stream of those bodies which when grouped in a certain structure perhaps form an atom of a certain kind. We are sure of the relative mass of an atom, but we are less positive concerning the composition of its protons, and we are not even certain that electrons do move in elliptical orbits about this centre composed of protons. Even if this knowledge were positive, we should not know what an electron is, nor could we describe the electricity which is supposed to "charge" the mass. The electron may not be the ultimate and indivisible unit of either force or matter. Some, however, even question whether an electron *is* a certain mass-structure of conventional matter existing independently of its force-expression? If an electron moves slowly,—let us say at ten miles an hour,—would its energy

of motion be described as electricity, an electric force, or would it be called something else? Has an electron ever been known to move along a wire from one atom to another (or in free space) at ten miles an hour? And there is a still more important question: Does some principle prevent free electrons from moving in the spaces between atoms and worlds at the speed of ten miles an hour?

These questions need not be fully discussed here. We shall merely designate as "electricity" the force given by the blows of a series of electrons moving at approximately 186,000 miles a second. The electron is the unit of "electric mass," or of electric momentum, or of electricity, and its velocity, when delivering the characteristic blow that is known as electric force, is typical of the velocity of translation of energy in a certain direction by electrons when moving between atoms and worlds. This characteristic velocity along the direct line of translation of energy is approximately the speed of the translation of light-energy. When thus moving, the electrons are probably manifesting (in the average) their share of the pressure-equilibrium of the pool within that certain volume which they control. If an electron should be split into something smaller the new mass, we believe, would not deliver the blow known as electricity. The bit of matter smaller than an electron, moreover, could not repeatedly oscillate in its structure with the identical velocity of the electron in its atom unless it formed the permanent part of a structure having (as a structure) the average density of the atom containing the electron.

The electron is the unit of negative electricity. What, then, is the unit of positive electricity? Certainly it is not the imagined proton, because no one has ever heard of an energy-expression of oscillating protons passing through a wire. Perhaps, as already suggested, the *reflex of a current of negative electricity* may be that which we call a current of positive electricity. When the balanced energy-equilibrium of an atomic structure with its normal environment is destroyed by an unusual energy-expression affecting it, the stream of electrons coming from this structure seems to originate that current of unbalanced energy which we

describe as "negative electricity." This stream of electrons leaves behind, as we have noted, a condition of energy-unbalance. It exhibits what might be termed an energy-and-matter vacuum—a temporary exception to the general principle that the energy of moving matter balances between adjacent volumes. The general principle of energy-equilibrium can be satisfied only by the return to this unbalanced structure of the same number of electrons that have been taken from it by the unusual and impermanent energy-receipt. Electrons, therefore, tend to return to the unbalanced atomic structure as rapidly as they are taken away by this artificial application of unbalanced energy to the heretofore balanced structure, and the energy of the returning stream of electrons may be incorrectly spoken of as due to the force of the "positive electrical attractions" of the unbalanced structure. The returning energy-stream may itself be designated as a current of "positive electricity."

According to this hypothesis, negative electrical energy is originated whenever electrons are forced out of their normal atomic volumes (volumes hitherto maintaining an energy-harmony with an energetic environment) and an equal current of "positive electricity" is displayed by the return somewhere else of this number of electrons to the source-volume. There are two kinds of electric force, then—that required to destroy a portion of the general equilibrium by tearing electrons out of their normal association with a then balanced structure, and the equal force exhibited by an equal current of electrons when, in obedience to the principle of energy-harmony volume with volume, they re-fill the vacated places in the atomic configurations.

The description of positive and negative electricity may be illustrated by analogy in any energy-pool. Negative water-force is consumed when one scoops water-molecules from a pool. This use of energy creates a hollow (or vacuum as to pressure) within the pool. Later a positive water-force is expressed when an equal number of water-molecules, urged by the general principle of pressure-equilibrium of the pool (the principle creating the energy-pool formation), rush back into this concavity. The hole in the water will be re-

filled at the first opportunity afforded by the conditions of this environment. The inrushing water-particles are not "attracted." Rather they are *impelled* back into their old structural relationship.

The measure of the force used in the re-creation of a disturbed condition of balance between the energy-manifestations in adjacent volumes is normally equal to the force required to disturb this energy-balance. This principle applies whether the forces are named electricity or something else. All such forces, however, are measureable as multiples of the momenta of a certain corpuscle moving with its characteristic velocity in this environment. The environment preserving the atomic pressure-equilibrium possesses almost perfect elasticity. It displays a mechanical reflex action more perfect than that of the pool of water. Positive electricity, therefore, represents the reverse of the negative principle, but the power of each is derived from the energy-condition which maintains the energy-equilibrium within the general energy-pool. The primary cause, even of electricity, then, is that Power which limits the volume of the universe, which gives motions to its parts, and which does this in order to accomplish its evolutionary purpose with matter thus moved and thus restrained.

Whatever means is adopted to cause the movements of electrons from their atomic structures, whether they be torn loose by frictions or dislocated by the actions of an electric dynamo, or whether they shoot forth in all directions as if "spontaneously" from radium or uranium, the energy derived from the blows of these electrons—provided the unbalanced energy moves with conventional speed and frequency in a certain direction—is identified as an electric force. With regard to "spontaneous" radiations, however, only negative electric forces appear, for the motions are not reversed. Perhaps these emanations are responses to irreversible changes in the average amount of energy of motion being manifested generally. If a radiation is really induced by the "spontaneous" dissolution of matter, it should certainly have no later reaction, and should, therefore, be

regarded as "absolute." In this respect it is different from an electrical action.

It is claimed that extraordinary events take place within the tiny atoms. According to the Bohr assumptions, the electrons revolving about the nucleus of an atom have a limited choice of speeds and also of distances from the nucleus. An electron cannot move in any orbit, but it may be found only in certain ones—those bearing a definite mathematical relationship to one another. This is an extraordinary postulate of conditions, and one that the physicists can give no reason for. Perhaps more remarkable, however, is the implied principle that the electron must know exactly how fast it must move in each orbit. As the electron changes from one orbit to another, it is supposed to select that orbital speed which will accomplish a certain predetermined result. Not only can the electron jump "spontaneously," but it never fails to develop through its change of orbit a certain planned change in its energy-relationship with the environment. Mr. Bertrand Russell says: "This seems to show that nature has a kind of foresight, and also knows the integral calculus, without which it is impossible to know how fast to go at each instant so as to achieve a certain result in the end. All this sounds incredible."[1]

We agree with Mr. Russell that "All this sounds incredible." Indeed, it seems much easier to explain mechanical phenomena otherwise. The assumption that electrons have a knowledge of the integral calculus, and an ability to move as fast as necessary to achieve a predetermined result, is beyond belief. Are we still dealing with physics? And is physics still treating only with inert matter? The statement of Mr. Russell seems more incredible than the theory that mind can control matter. Yet physicists are brought to this irrationality as they attempt to develop a temporarily acceptable theory—one which, for the moment at least, will interpret events according to their concepts. Compared with these assumptions, Professor Einstein's theory (which, unfortunately, does not refer very definitely to that which happens within the atom) seems quite simple and plausible.

[1] Bertrand Russell: *A B C of Atoms*, p. 140.

Nor is this all. We are asked to believe that action may take place through empty space without time being consumed in the act. When an atom gives off light, it is supposed that its electrons hop from orbit to orbit instantaneously. Mr. Russell says: "When an electron jumps from one orbit to another, this is supposed to happen instantaneously, not merely in a very short time. It is supposed that for a time it is moving in one orbit, and then instantaneously it is moving in the other, without having passed over the intermediate space."[1]

We are asked to assume that the electron moves, but passes over no appreciable space-time in moving. It jumps, but even when its act is referred to a single frame of reference it consumes no time in the jumping. Both space and time are here annihilated—at least so far as possible appreciation is concerned. And why? The hypothesis merely seems to be necessary. It is supposed that the electron simply forgoes space and time in its movements through emptiness. No one can give a reason for it. It is not believed that matter can ordinarily move by itself. Yet, in order to make the facts harmonize, it must be assumed that at times electrons, when moving in atomic orbits, become dissatisfied and jump because they wish to. The electron jumps with "foresight." It "knows the integral calculus" and moves to "achieve a certain result in the end." It jumps, but no explanation is given of the source of the energy which gives it motion. It also jumps certain definite distances, and not in haphazard fashion.

Mr. Russell asserts further:

> The process by which an electron passes from one orbit to another is at present quite intelligible, and to all appearance contrary to everything that has hitherto been believed about the nature of physical occurrences.[2]

Modern physics has here certainly reached the unreal! Surely it must be building upon an incorrect assumption of principle! Never before in any of man's relations with mat-

[1] *Ibid.*, p. 54.
[2] *Ibid.*, p. 54.

ter has he found the mechanical facts so weirdly complex, so far beyond human understanding. Motion without a cause, infinite velocity consuming no time and arriving at a new position without traversing space, the simultaneous being of one piece of matter in two places, anticipations by electrons of positions for future accomplishments—how can these be conceived as real? Faced with these astounding puzzles does one not have the right to question seriously the assumptions of physics? Is it not possible that this science has been established on generalized formulations of experiences which are so untrue of the particular event that unreasonable suppositions must be introduced to reconcile them? Isn't this perhaps the explanation of the extraordinary inconsistencies that are revealed when the assumed atomic relationships are considered? Indeed, the broader minded physicists admit that their theories are merely temporary working hypotheses finally to be displaced. Nor does the new atomic theory of Schrödinger dissipate the fundamental difficulties.

It is supposed that the resistance of atomic structures to exterior aggressions is due to the unwillingness of electrons to be pushed closer to their nucleus. But if the nucleus has a positive electric charge that attracts electrons, why should these bodies be unwilling to move closer to that which attracts them? To make the point clearer, let us ask why the earth resists being pushed closer to the sun.

Gravitational "attraction" (as those say who do not accept Einstein theory of curved space-time) supplies the force which holds the earth in its slightly elliptical orbit. Otherwise it would move in straight lines into infinite space. If the earth were started off with its present tangential velocity, but closer to the sun, it would be curved insufficiently to bend its straight-line motion into a repeating curve at this average distance. But, if insufficiently curved, it would not go over the same path twice, hence its second orbit would be out farther than the first one. If left alone it would soon be back in its former balanced orbit. For this reason the earth, if it were knocked into a smaller orbit than it is now in, could, because its motion in that orbit would require an unusual amount of force for its maintenance, balance in the

new orbit an unusual amount of exterior force—an amount that would otherwise tend to bring it still closer to the sun. Let us accept this for the moment as the explanation of the ability of the earth to resist orbital compression. At certain specific mean orbital distances, then, the planet, whether earth or electron, is in perfect equilibrium with all the usual forces being exerted upon it. When forced to a closer mean distance, more than the former average energy must be delivered to it from the environment if this orbit is to be maintained.

If this theory be true, how are we to suppose that an electron, unaffected by its environment, can suddenly hop into a new relationship with the atomic nucleus? Isn't this concept as unreal as the idea that the earth could suddenly, without cause, leave its normal orbit and instantly appear in an orbit closer to the sun, or that it could revolve in balanced satisfaction at many different mean distances from the sun? Mr. Russell's statement about the changes of orbits of electrons presupposes, to begin with, that there are no resistances to a change of orbital distances, and that perhaps even the mass of the electron (the outcome of the theory) ceases to exist. The electron is supposed to change its orbit without regard to the attractions of the nucleus. Immediately after a jump away from the nucleus it revolves with a changed orbital velocity in a path in which it may be regarded as expressing a different amount of orbital energy.

This small mass of great density is supposed to be able to make millions of revolutions a second about a nucleus at an almost infinitesimal distance from it. We are asked to assume that the electron is deflected into its repeating orbit by no other force than the electrical attraction of a body about 1,850 times larger than it, and having the attraction of a single positive electric charge. While thus being curved, however, it suddenly has an inspiration: It ceases to exist,— and is thus enabled to disregard the forces of attraction. It simultaneously re-appears in a new existence, and is found instantly moving with a new velocity in this new orbit. Energy appears, it would seem, as a creation of a non-existing principle. Such assumptions must be ac-

cepted if one is to explain the emanations of light-energy according to the Bohr hypothesis. Yet, how can one understand the simplest of all the assumptions—namely, that the attraction at a distance of one proton is able to supply the required unceasing energy to an orbit when moving at such velocities and when influenced by other masses, and when in contact with other atoms in the environment? Most of these suggestions seem unreal, but let us continue.

If the Conservation theory is true, when the electron jumps from one orbit to another, and when the energy expressed in its new orbit is less than that in its old path, the energy which the electron has lost *must* have departed from the atom. We reach the desired development of the theory when we inquire what becomes of this lost energy. The physicists assume that it is accounted for in the emanations of radiant energy. Here, then, is perhaps the explanation of radiant energy that the physicists have been seeking. Here, they hope, they have discovered the source of the light-and-heat-radiations. Is this suggestion satisfactory in its general term? We shall not attempt to describe here the particular features of the hypothesis which are unsatisfactory even to those physicists who have accepted the Bohr atom as being the best explanation thus far offered. Let us rather continue to deal with the more general terms of the concept.

The electron, while moving placidly in an orbit, is suddenly impelled to jump. No known force repels or attracts it, or bumps it, but, nevertheless, it leaps. It neither gives off nor consumes energy of the usual type in the phenomenon of leaping, for the jump from orbit to orbit consumes no time nor space. Neither kinetic energy nor momentum is required to stop its motion away from the nucleus. It stops by itself—by means of its own volition. Nevertheless, after the jump has been concluded the electron finds itself in a new orbit where, though still revolving about the nucleus, it expresses a different amount of energy. The energy due to the change of orbital position is emitted, yet we must remember that the radiant-energy (if the change of orbit is its cause) is supposed to start from its source instantaneously, for the

electron consumes no time in moving from orbit to orbit. One cannot say, therefore, whether the starting or the landing orbit is the source of the energy-emanation. Nor can one understand why the light is emitted in all directions. Passing by these difficulties, it would appear (according to conventional mechanics) that the energy-charge which develops light-rays should be infinite, for no time is consumed in creating the changed velocity of motion of the mass. Furthermore, an equally infinite energy would be required to stop the mass-motion of the electron instantaneously. No explanation is offered by Bohr as to the source of these infinite forces. Are these not strange assumptions? How can they be seriously regarded by persons who, for the most part, are unwilling to admit even that a mental power might make matter move?

The electron is supposed to leap, not because it has been struck by another mass, but because it *wills* to jump. It leaps because of its volition. Therefore, since it loses energy from this change of position, and since the lost energy is expressed in radiations, volition must be the cause of the energy-change and of the radiations. These light-and-heat-rays, however, emanate either from radioactive matter or from bodies subjected to abnormal collisions.

Now we cannot believe that the volition of an electron is the cause of light-radiations. We are merely setting forth here the conclusions that follow from the Bohr suggestions. If an electron which was revolving in an atomic structure and which was held within this energy-volume by exterior blows, was struck unusually by another body from the outside, and if it was unusually accelerated by the blow, and if, at the same time, it was forced to a greater than normal distance from the nucleus so that the atomic structure was unusually expanded in this particular direction, we should perhaps understand the mechanical cause and the mechanical process involved in such a change in the energy-relationship at this point in space. Mechanics might possibly explain each step of this procedure. If, however, we were asked to assume that no time was required for the electron to move from place to place, we could not interpret such a

happening in mechanical terms. Nor would we understand the emanations of *pure-energy* (energy-waves in an imponderable ether) *from* the structure. Light-energy is inexplicable as a radiation of energy unless it begins as an outward movement of mass—and also continues as a wave in a fluid *with* mass.

We can imagine an expansion of structural formation whenever a composite grouping of a balanced energy-volume containing many moving bodies is struck unusually from one or more directions. Matter might even emanate then from such a structure to account for the beginning of the light-energy effect. In fact, we do not see how some radiations of masses completely separating themselves from the structural formation can be prevented in every collision of a certain type. The outward movements of masses for certain distances (until resisted sufficiently by other opposed mass-motions in the surrounding fluid), after unusual blows, seem inevitable, and are subject to interpretations; but "spontaneous" energy-radiations from, or changes of orbital relations within, a balanced structure are inconceivable. Nor does the scientist account through his ether-wave theory for those emissions of energy in terms of emitted matter which *must* occur normally when one composite energy-structure is pounded with unusual vigor by another. Material parts must be permanently emitted in many such cases, and if they do not create light and heat, what effect do they have? If our solar system received a tremendous blow from the outside, would not one of the planets escape from the sun for ever? Surely it would, and this happening in a group wherein different planets attract one another would be more apt to occur where the planets, as in the atoms, are supposed to repel one another.

From within the heart of an atomic structure, light-energy starts moving outwardly, and, according to the modern assumptions it moves with the equivalent of volition as its cause. In many cases the motion is supposed to be "spontaneous"—or without mechanical source. Thus we are forced to attribute to an unmechanical principle within the electron the power of "absolute" causation, or the ability

to over-ride classical mechanics—qualities and powers which many scientists have hitherto been unwilling to concede to a human being.

Many physicists feel that it is practical, and therefore wise, to ignore the more or less self-evident contradictions in their assumptions. They incline to accept the most practical suggestion. They also stop short of the final deduction, and usually fail to admit that their new hypotheses, with spontaneity and volition included, are inconsistent with Conservation.

Let us now illustrate here a rather typical philosophic point of view as held a few years back.

Paul Carus was a monist who believed that the unity of the universe was founded on a unity of order or form. "Form," he said, "is the condition of its cosmical order and of its intelligibility." "Man's personality, his mind, his intelligence, his character, is the special form in which the atoms have taken shape."[1] To Carus, mind was a special form of life. "Volition and human action are special forms of motion, and so are all manifestations of the life of the organisms." He said that some persons lose sight of the fact that "matter, motion, and form are more abstractions, and that none of them exists or can exist of itself. They are only three aspects of reality. Reality, being one indivisible whole, possesses properties for which matter, motion and form are general terms."[2]

Carus was once asked to explain in harmony with mechanics the origin of the force that gives motion to a stone thrown by a man's hand. He replied: "Conservation of energy means that the sum-total of all kinetic and potential energy remains the same in the whole universe. . . . There is no creation in the old sense for any annihilation, but only change from one form of energy to another."[3] Here he merely stated the theory of the mechanist.

While Carus was unwilling to concede to man the power to cause a new motion, he was willing to concede self-motion,

[1] Paul Carus: *Fundamental Problems,* p. 94.
[2] *Ibid.,* p. 93.
[3] *Ibid.,* p. 106.

or spontaneity, to all life-forms. At the same time, he believed that all the motions of life-forms had a prior cause. His reasoning here became confused. He said: "Spontaneity is a quality inherent in all matter and if spontaneously moving bodies have to be called alive we must acknowledge that nature throughout is alive." [1]

He also remarked that:

> Self-motion is, therefore, life in a broader sense, and the phenomena which are exhibited in protoplasm must ultimately find their explanation from the form of protoplasm as a special and complicated instance of the simpler self-motions of inorganic substances.[2]

Carus believed that "the universe with its life and motion cannot be mechanically explained"; but, like most mechanists, he was unwilling to think that the motion originated by an atom, or by an organic life-form, could be anything else than an inheritance passed on through a mechanical chain from an indefinite past. He was unwilling to concede the presence of an original source of motion active in the universe at large. He would not admit that the motion of matter was constantly destroyed without compensations, and then later renewed; and he was unwilling also to think that perhaps organic life-forms possessed some of this power to originate motion.

We, in turn, admit, that electrons *may* possess some of the "absolute" powers conceded by us to life-forms; but, since the motions of electrons never appear to be based upon unmechanical principles, we feel assured that the power of motion possessed by them cannot account for the radioactivity of uranium. We believe that the cause of the important motions of electrons is not spontaneous in the sense that it arises either from the power or the volition of the electron. Here we agree with Carus rather than with Russell. The electron does not have appreciable life-characters, hence its motions must be attributed to a cause exterior to it. Otherwise the Conservation doctrine would be voided

[1] *Ibid.*, p. 113.
[2] *Ibid.*, pp. 117–118.

by the will of an electron—by the mind-power in the very unit of matter.

Many modern scientists do not seem to object particularly to concepts that lead to such a denial of Conservation provided that the phenomena are sufficiently minute and particularized; but other modern physicists, more searching in their analyses, and more thorough in their deductions, make assertions similar to those of Mr. Russell. They attribute to electrons the mental powers of change and of creating motions to an unimaginable degree. They thus appear to go beyond the necessities of their problem—or, at least, beyond the requirements of a different premise that they might have chosen.

With a different definition of light; with a different understanding of atomic structure; with the assumption that a definite structural form is being maintained in an atom by external energies of motion, even while its separated parts are moving to and fro, with an acknowledgment that there is a *created* energy-equilibrium of matter-particles in motion of which every balanced atomic structure manifests its share, these scientists would be equipped with principles which would permit them to understand the emanations of matter from an atomic structure as events in harmony with unusual alterations in the energy-situation of the energy-volume in question. When subjected to unusual energy-receipts they could understand the nature of the directional expansions of the atomic structure.

They could perceive why these expansions would induce unusual energy-waves in a surrounding material fluid. They would not be obliged to have recourse to the assumption that electrons move when and as they want to. They would then be able to understand both the cause and meaning of positive and negative electricity.

Provided with a theory of Change, they could use a similar train of reasoning to explain the energy-emanations known as light and heat. Radiant light might then be interpreted as resulting from unusual external deliveries of blows to certain previously balanced material formations, followed by certain expansions of these formations in cer-

tain directions in a fashion that would naturally create unusual and appreciable energy-waves through the surrounding fluid in these directions. In fact, some scientists are now favouring the view that light-energy is a mass-energy—although at the same time they rather confuse the issue by failing to distinguish between mass and energy. The following passage states the case:

> Yet the work which won for Professor Compton the Nobel prize introduced the most interesting controversy of present-day physics; that is, whether radiation consists of waves or minute particles . . . The phenomena with X-rays result entirely in accord with our expectations if they obey the same laws as ordinary light . . . . Attempts to account for this phenomenon on the basis of waves have not been successful. Simple explanation is, however, found in the assumption that the X-ray consist of rapidly moving particles which we may call photons which are deflected by electrons . . . . Unless there is some fault with this experiment (that of following the photon from its collision with two successive electrons) it would seem to show definitely that the X-rays consist of minute particles. . . . Yet it is certain that the two types of radiation, light and X-rays, are essentially the same kind of thing. We are thus confronted with the dilemma of having before us convincing evidence that radiation consists of waves and at the same time that it consists of corpuscles.[1]

Let us now examine the so-called "spontaneous" radiations from the more complex atomic structures. These may be explained by a simple concept which seems mentally *necessary* if the universe is finally to reach that unity which alone can satisfy reason. We ask again merely for the admission that a Power is operating creatively in a dualistic universe, and is converting the dualism into monism through an evolutionary process which consists of the transformation of the material arrangement into its non-material essence. If one can but grant this, the inference follows that the energy-equilibrium of the matter of the universe will be repeatedly

[1] Watson Dawis: *The Evolution Theory Entering a New Phase.* In Current History, February 1928, pp. 710–711.

disturbed, and this change, while irreversible, might even seem "spontaneous" to one who denied the Evolution. The emissions of radioactive particles spring from the adjustments of those energy-relationships which necessarily follow the general evolutionary changes. They occur in answer to increases in the average energy-potential, and not, we think, because there is a progressive reduction in the average of the energy-potential as the second law of thermodynamics calls for. These radiations are not mysteriously self-caused. An active Power, in having its way with matter, creates them purposefully.

Paul Carus said: "The monistic conception considers the world as a cosmos, *i.e.* an orderly arranged whole. Monism says: 'The world and the phenomena of the world are orderly arranged, according to mechanical law'." [1] Yet not all phenomena are orderly in the sense that they represent perfect energy-reciprocity. In fact, when one looks at the whole, there is no general energy-reciprocity, and no energy-relationship that can be broadly interpreted in terms of mechanical axioms.

Grant, then, that an external, concentrating Power acts upon the units of matter, and we may depend upon having two breaches in the assumed "orderly arranged whole." First we must remember that the generalized order which even the whole displays, is internal solely, and it does not include or take into account the reversals of motions at the bounds. The average molecular motion in a pool of water, its energy-balance as a whole, appears to be "orderly" and balanced in the average, but only when the reversing powers of the banks are not considered, and only when the evaporations and whirlings are disregarded. And there is a second breach in the total "order." It is due to that Evolution in matter which stands for the accomplishment of the Purpose which has endowed (and which is repeatedly endowing) matter with orderly motion. After a certain order has been broken by Evolution, it is never restored thereafter. Nevertheless, any one certain condition of unbalance endures only

[1] Paul Carus: *Fundamental Problems*, p. 47.

during the interval required for the universal movements of corpuscles (under the influence of orderly forces) to be brought into a new order. The pool from which water is permanently removed is never again as it was, but the matter of the new pool will soon display a new structural equilibrium throughout. Not the same cosmos, but a new one, appears; and this new condition, so long as it endures, is as dependable in its "order" as the old. Some kind of balanced structural formation, then, is always with us. Nevertheless, one order is constantly being replaced by another that is almost, but not quite identical. Since the new order corresponds so closely with the old, since the restoration of order takes place so quickly, we sometimes conclude erroneously that one order is for ever permanent, and, since we have never reached the bounds where average motion is reversed, we have been inclined to regard the pool of the universe as self-contained, and as self-created even in the reversed motions of its parts. Strangely, we have been inclined to try to interpret the reversed motions of matter-bodies in terms of a monistic mechanism.

Emanuel Kant was particularly impressed by the general "order." Conceptions of a perfection of "order" are unreal, however, in that they allow no place for Evolution, and no place for the Power which creates the order merely that it may be broken. In a universe of fixed order there would be no accomplishment, and no "absolute" change. There would not even be a measure of motion that might be followed by a reduction of energy-potential. A condition of perfect order as the representation of a moving and changing world is unsound philosophically. One cannot feel that a mental power would create structure, form, and some measure of order within dead matter, unless accomplishment is to reward the effort. We believe, therefore, that there is a continual destruction of order, and that the Evolution of matter through time, and not its temporary order, is the more significant principle. We believe that there is a consistent and progressive alteration in the forms of atomic structures. This gradual simplification is due to the changes induced by evolution. Does or does not this theory corre-

spond with the phenomena which have hitherto been regarded as examples of "spontaneous" mechanical changes?

The structural form of the atom is altered at the time that the change in external pressure causes its former balanced formation to be inadequate for the new energy-conditions. The very necessity that a new formation should be adopted accounts for the unexpected motions of some of the atomic parts. In respect of the more complex atoms, this readjustment of parts to the new energy-field results in a happening analogous to boiling in which a water-structure loses some of its drops by the radiations of steam-particles. Such a phenomenon is illustrated in the decomposition of radium. The pressure-changes being widespread, fairly uniform decompositions of structure occur from place to place. We require "order" even in the process of changing, for, as Carus said, consistency is essential—and especially necessary if we are to have dependable rules, laws, and formulations.

Carus went so far as to say that an "explanation becomes necessary only when consistency is lacking." Yet a significant consistency obtains, after all, when, as one mechanical "order" breaks down, it is followed by another even more simple. This consistent change in order, if it is never reversed, and if it signifies more than an equalization of the energy-potential of the universe, signifies accomplishment. It stands for an "absolute" attainment, and is therefore more important than a continuing fixity, or static self-consistency. The order of the universe must be fairly uniform from place to place, for the process of change is slow; but more important than this uniformity of order are its orderly changes. Here a thought is suggested that should be further considered. Does the changing order have a sequence which subscribes *necessarily* to the dictates of a general Power, or may this routine be varied by mental powers here and there? We shall touch upon this but briefly.

The change, or break-down in that which was orderly, is significant. Both the average status and the passing from one status to another represent that which a powerful Will has ordained. Yet, is it "necessary" that one certain result

should follow? The order of the physical routine and its change are both the accomplishments of a Creative Power, but another will, even that of a man, by concentrating on part of the environment may impose its purpose and plan upon that particular situation. There is room within the general routine of the whole for the application of a particular judgment, choice, and mental will. Although these local influences may be of limited scope, although there may be definite bounds to their accomplishments, the natural conditions developed by the free-will of a man may yet be more important in his everyday life than the wider-flung but more gradual changes of the general Power.

Because a man possesses a measure of free-will, he has the ability to choose from the many physical paths that are made possible when the laws of mechanics have thus been set aside, and, because the human will can somewhat create its own environment, man should recognize himself as a significant participant in his own affairs. He is somewhat the maker of his own life. He is partly the captain of his own soul. And since there is this process of general change in the midst of caused motions, the result of man's choice of directions is particularly important to him. Thus he can partly control both the wind and the tide without passing bounds of the influence which are staked for him—although he can perhaps neither cause the wind to blow, nor the tide to rise.

While the general pressure, order, structures, and forms of matter-bodies are regulated and ordained by a major force-principle (that principle which in some of its aspects we mistakenly call mechanical determination), man, too, can act and ordain and accomplish. He does so to a limited extent. And though the universe as a whole exhibits fairly consistent order and dependability, nevertheless a certain measure of its order is contingent upon and subject to the deviation and direction of the human will.

As Professor Will Durant writes of William James' belief:

> Where there are cross-current and warring forces our own strength and will may count and help decide the

> issue; it is a world where nothing is irrevocably settled, and all action matters. . . . In a finished (or monistic) universe individuality is a delusion. . . . But in an unfinished world we can write some lines of the parts we play and our choices mould in some measure the future in which we have to live. [1]

Durant avers that "the theoretical evidence for such free will, or such a multiverse, or such a finite God, is as lacking as for the opposite philosophies." We disagree with him. The theoretical necessity forces itself upon us. It is difficult to prove the necessity only if one is so old fashioned as to try to use the answers of the conventional mechanistic formulas as the proof.

The British scientist and philosopher, Professor A. S. Eddington, while he does not demonstrate the ability of mental power to overrule mechanical determinism, has this to say on the subject: "It is a consequence of the advent of the quantum theory that *physics is no longer pledged to a scheme of deterministic law.* Determinism has dropped out altogether in the latest formulations of theoretical physics and it is at least open to doubt whether it will ever be brought back. [2] The future, he says, is unpredictable, "not merely because it is impracticable to obtain the data of prediction, but because no data connected casually with our experience exist. It will be necessary to defend so remarkable a change of opinion at some length. Meanwhile we may note that science thereby withdraws its moral opposition to free-will." [3]

Later he remarks that "There can be no fully deterministic control of inorganic phenomena unless the determinism governs mind itself. Conversely, if we wish to emancipate mind we must to some extent emancipate the material world also. There appears to be no longer any obstacle to this emancipation." [4] And again: "I think we may now feel quite satisfied that the volition is genuine". (p. 311) And finally: "It seems that we must attribute to the mind power

[1] Will Durant: *The Story of Philosophy*, p. 561.
[2] A. S. Eddington: *The Nature of the Physical World*, p. 294.
[3] *Ibid.*, pp. 294–5.
[4] *Ibid.*, pp. 310–311.

not only to decide the behaviour of atoms individually but to affect systematically large groups—in fact to tamper with the odds on atomic behaviour." (p. 313) What a concession from an eminent scientist! It appears that the person who would deny our definition of mental freedom must deny at the same time the opinion of one of the leading scientists and exponents of the Einstein theories. Professor Eddington even tells us that, "The idea of a universal mind or Logos would be, I think, a fairly plausible inference from the present state of scientific theory; at least it is in harmony with it." (p. 338) He speaks of a background of physics "which we are at liberty to, or even invited to, fill with a reality of spiritual import." (p. 339)

We, too, believe in this universal mental power, and here we are trying to disclose the reality of the human mind as well. We believe that the human mind has its separate significance, although we will admit that its independent activity is limited. There are often several possible particular conditions, however, which will satisfy a general requirement. Thus a total of twelve (12) may be reached by several numerical combinations which are equally perfect mathematically, and which will equally satisfy the general dictum that the numerical summation must have the totality of twelve (12). A general power may ordain the fact, "twelve" (12), but another may have the prerogative of selecting the combination of eight and four, rather than the other, equally possible, of nine and three. There is a range within which the lesser Will may exercise a measure of control that is displayed through its individualistic power of choice. Within prescribed limits the use of choice by a human free-will does not interfere with the larger plan.

And while it seems apparent that both the general Will and the wills of life-organisms have contemporaneous reality and validity even in controlling the motions of matter (the human free-will, however, controlling, perhaps not the amount of mechanical energy, but merely its time of expression and its direction), nevertheless, as far as we can perceive there is no effectual free-will on this earth except in the recognizable organic forms. For this reason we do not be-

lieve that light-radiations take place merely because electrons possess the power and the volition within themselves to change their positions within atomic structures. Nor do we believe that any of the movements of matter are "spontaneous". We contend that if volition is to be taken as the cause of the activities within atoms it must also be accepted as a cause elsewhere. Once it is admitted, however, that volition may be a more or less general cause of motions, it is no longer necessary to account for them otherwise. And if we grant the presence of a sufficiently universal Power of motion-giving we shall no longer be required to imagine other force-factors. This is our Science, and this our basis of Faith.

CHAPTER XV

THE THEORY OF ATOMIC STRUCTURE (CONTINUED)

Knowledge of Nature or of absent experience is accordingly no less questionable in its texture than in its scope.

SANTAYANA.

ACCORDING to the Bohr theory when the electron jumps from one orbit to another energy is given off. These radiations are found to occur in multiples of an exceedingly small invariable quantity of energy called the quantum, or h. When the electron jumps it is supposed that its orbital speed changes, but the slowest orbital velocity, and therefore the one expressing the least energy of motion, is said to be that of the single electron as it moves in the smallest orbit of the hydrogen-atom. No mechanical explanation has been given for the sudden changes of orbital speeds and positions, or for the particular directions of the emanations, or for their velocities of emission.

Let us now ask some simple questions: Can orbital velocity change instantly, or change at all, merely because the electron wants to betake itself to a new mean distance from its nucleus? Can acceleration thus be promoted? Or, can the movement from orbit to orbit be either spontaneous or instantaneous?

According to classical mechanics if the speed of a moving body is increased its acceleration must either be derived from the contact of another mass moving still faster in the same direction or it must originate in some attractive force. In the case of radium-emanations, however, we are told that they are not due either to contacts or to "attractions", but that they are "spontaneous". And, when an atom is subjected to rays of radiant energy (whatever they may be)

we are asked to believe that the planets of the atomic structure (and never the larger mass of the nucleus) instantly absorb this energy in multiples of a definite quantum-quantity, and then, *instantaneously,* find themselves at a certain greater mean distance from the nucleus. In the new orbits the planets are supposed to express (?), or represent (?) (we are not told which), amounts of energy greater during each revolution than the former energy-expressions, or energy-representations. Yet the planets receive this additional energy-quantity only once from the outside. One energy-receipt makes one orbital change. It is not understandable how this energy might be received one time only and yet be expressed by,—or at least be represented in,—several orbital revolutions thereafter. It may not be thus represented thereafter, however, for, as Sir James Jeans has informed us, it is an unexpected but essential "feature of the whole theory that even if the hydrogen atom charged with its . . . ergs of energy is left entirely undisturbed, the electron must, *after a certain time,* lapse back spontaneously to its original smaller orbit, ejecting its . . . ergs of energy in the form of radiation in so doing. Einstein showed that, if this were not so, then Planck's well established 'cavity-radiation' law could not be true." [1] The words, "after a certain time" in the above paragraph might, of course, mean as soon as the action *can* take place in space and time.

We quote from Sir James because he is acknowledged as one of the most distinguished of living scientists, and also because his book was published (1929) after this chapter was first written, and is therefore a late word. The reader will note that the return of the electron to the orbit of smaller energy-content is spoken of as being "spontaneous". How, otherwise, could the mechanists explain the orbital changes? Physicists agree that the "attractions" of the nucleus cannot affect average orbital positions and velocities. If, therefore, neither unusual contacts with other forms of matter nor unusual "attractions" cause the electron to return to its low-energy orbit, "spontaneity" *must* be the cause. This is the dilemma in which this school of thought finds itself.

[1] Sir James Jeans: *The Universe Around Us,* p. 124. (Italics mine.)

And while the Schrödinger theory of atomic structure, involving as it does an imaginary sub-aether, may correspond more closely with the accredited facts, it too, involves many inconceivabilities.

To an unscientific mind it seems natural that whenever the delivery of radiant energy from the outside causes a change in the mean distance of an associated electron with its atomic sun, about half the time the energy-receipt would cause the electron to move (at least at the start) closer to its nucleus instead of farther away. If a meteor bumps the earth the result of the collision, in so far as it relates to an increase or decrease in the distance of the earth from the sun, depends first, upon the direction of the meteor in respect of the sun at the time of collision, and secondly, upon the direction of the earth in respect of the sun. About half the time we may expect the collision to drive the earth closer to the sun. And as to this exterior radiant energy, which, by its contact with the atomic structure, is supposed to increase the orbital energy (and, therefore, the average distances of planetary electrons from the nucleus), we must remember that it is assumed to be nothing but a wave in an imponderable ether or "field of force". As it is explained this activity is a mystery. And when, later, the planetary electrons return to their old associations with the nucleus, we are asked to accept "spontaneity", or volition, or free-will, as the cause of the seemingly voluntary and instantaneous return.

We do not exaggerate when we say that modern scientists find themselves in the midst of insoluble contradictions and paradoxes as they attempt to explain atomic phenomena in terms of Conservation. They are now attempting to reconcile themselves to these unscientific (or at least unreasonable) positions by saying virtually that science is no longer concerned with self-consistency or reasonableness. Thus, Professor Eddington, in the introduction to *The Nature of the Physical World* (his recent Gifford lectures), writes that scientists "do not even desire to manufacture a familiar counterpart to these things [ether, electrons, quanta, potentials] or, as we should commonly say, to "explain" the elec-

tron." And again: "It is not at all necessary that every individual symbol [of science] . . . should represent something . . . explicable in terms of common experience." "The frank realization that physical science is concerned with a world of shadows is one of the most significant of recent advances."

There is something almost pathetic in this. The field of mental endeavour which was formerly claimed to be capable of developing the most exact human knowledge is now described as being satisfactory even though it is regarded as admittedly a field of irrationality. According to this latest view one is credited with having taken a tremendous step forward when he comes to realize, and then frankly admits, that scientific principles are not to be explained in terms of human experience (that is, in terms of human understanding), and that science treats only with "a world of shadows". This is the viewpoint of many of the more modern and broader scientists who perceive the difficulties in their present situation, who frankly admit them, and who accept the implications that follow from this admission. Yet is it really an "advance"? Is it a step in the right direction that physics should now be forced by the paradoxes confronting it to admit that it is indeed "concerned with a world of shadows"? And can philosophy justify such an admission on the part of science? If the philosopher believes that mind-power (and its reasonableness) is the greatest reality, shouldn't he here interpose his objections? Certainly this is a strange pass to which the scientist has come! Surely there is an escape which does not involve such a complete avowal of the failure of reason! Practicability is not our only goal; and irrationality cannot be justified to reason.

Sir James Jeans, in describing atomic relationships, says:

> So far as our experience goes, an atom, as soon as it reaches this state [the state in which its electrons occupy orbits of the lowest energy-contents, one electron in each orbit], becomes a true perpetual motion machine, the electrons continuing to move in their orbits (at any rate on Bohr's theory) without any of the energy of their motion being dissipated away, either in the form of ra-

> diation or otherwise. It seems astonishing and *quite incomprehensible* that an atom in such a state should not be able to yield up its energy still further, but, so far as our experience goes, it cannot. And this property, little though we understand it, is, in the last resort, responsible for keeping the universe in being. If no restriction of this kind intervened, the whole material energy of the universe would disappear in the form of radiation in a few thousand-millionth parts of a second. If the normal hydrogen atom were capable of emitting radiation in the way demanded by nineteenth century laws of physics, it would, as the direct consequence of this emission of radiation, begin to shrink at the rate of over a meter a second, the electron continually falling to orbits of lower and lower energy. [1]

We note that Sir James makes extremely important admissions. He concedes that the parts of the atom are restrained into an orbit (or cycle of reversed motion) without the consumption of energy as definable in terms of conventional mechanics, and, correspondingly, without the anticipated delivery to the environment of any of the straight-line energies of motion of these parts. This action takes place in a way that is regarded as quite incomprehensible because contrary to the principles of nineteenth-century physics. And Sir James admits that this inconceivable state of affairs in which the parts of the atoms do not obey accepted mechanical laws, although the situation is typical of the structure of every atom of every element,—or, so to speak, of every mechanical relationship in our earth and elsewhere,—is "responsible for keeping the universe in [restrained] being."

This concept virtually amounts to a surrender of the basic axioms of mechanics. It constitutes, in fact, a complete *volte face* in principle. It even supports the principles that our theory calls for. It is virtually an admission that the activity of a Power overruling the doctrine of Conservation is responsible for the permanency of the small structural groupings of matter. The atomic structures to which this principle applies, however, constitute the building blocks of all structures. The surrender is complete, for in the classi-

[1] *Ibid.*, p. 127. (Italics mine.)

fication to which Sir James' admission logically refers must be included, not only the tiniest configurations of electrons oscillating past an atomic nucleus, but the physical matter composing the entire restrained universe—even the parts of the stars and their planets. After adopting the viewpoint of Sir James we are surprised that the modern scientist has failed to relate the new principle to the general situation. It would seem that a logical concept here appears which should be used as the proper beginning of the interpretation of mechanical phenomena in philosophical terms. Instead, however, even Sir James seems inclined to wait for more refined experimental data before taking the step consistent with philosophical reasonableness as here suggested. He hesitates to introduce such a revolutionary principle into the fairly satisfactory physics of every day use. Probably he demurs because this physics *is* ordinarily so satisfactory. Was it not derived from that which affords our most dependable knowledge—namely, experience? Let us continue with the views of Sir James, however, so as to learn what would happen *if* the conventional laws of physics (as was formerly believed) applied to the tiny building-blocks of all physical structures.

> After about a thousand-millionth part of a second the nucleus and the electron would run into one another, and the whole atom would probably disappear in a flash of radiation. By prohibiting any emission of radiation except by complete quanta, and by prohibiting any emission at all when there are no quanta available for dissipation, the quantum theory succeeds in keeping the universe in existence as a going concern.
>
> It is difficult to form even the remotest conception of the realities underlying these phenomena. The recent branch of physics known as "wave-mechanics" is at present groping after an understanding, but so far progress has been in the direction of co-ordinating observed phenomena rather than in getting down to realities. Indeed it may be doubted whether we shall ever properly understand the realities ultimately involved; they may well be so fundamental as to be beyond the grasp of the human mind.
>
> It is for just this reason that modern theoretical

physics is so difficult to explain, and so difficult to understand. [1]

As may be noted, even in the face of minute phenomena which directly contradict the interpretations of the principles governing these same phenomena in gross, the physicists are endeavoring still to explain the larger phenomena in terms of their old mechanistic principles. At the moment it is hoped that a still strictly orthodox mechanical explanation may be derived from the researches in "wave-mechanics" such as the Schrödinger theory treats with. It is remarkable, truly, that the mind of man goes to such extremes in his endeavour to explain life in terms of assumptions which, if valid, would negative the reality of his own mental principle. Sir James thinks an explanation of the paradoxes (developed through this stubborn clinging to Conservation) is probably beyond human capacity. So long as scientists adhere to their completely mechanistic premises, and endeavour to make their explanations correspond therewith, this pessimistic view will probably be justified.

We therefore call attention once again to the more reasonable explanations that present themselves when the mechanical movements are regarded as purposefully created (and also as purposefully restrained) from moment to moment by a Power overruling mechanical determinism. The activity of this purposeful Cause is illustrated in these very tiny cycles of atomic particles. Through this principle (potent from universal bounds to core), inert substance remains within certain bounds even while the bits of matter repeatedly oscillate in reversing cycles, and even though these cycles call for the repeated use of "absolute" energy. An orderly and restrained universe is thus maintained in the face of the tendency of moving matter in general (when undisturbed) to move endlessly, not in a space-time naturally curved about the centre of general mass, but in straight lines into infinite space. We attain this satisfyingly reasonable conclusion without recourse to inconceivables.

A limited composite structure within a larger energy-

[1] *Ibid.*, pp. 127–8.

volume may lose some of its parts. If we are permitted to assume that light-and-heat-radiations begin as unusual structural expansions of limited energy-volumes, as the receipts of unusual momenta from the immediate environment, and that these abnormal energies are transmitted to, and delivered by, the material fluid of the environment (the material fluid being that corpuscular medium which our theory postulates as a substitute for the ether), we may also assume that these unusual energy-expressions are received as blows of ponderable masses of the usual definition. In such terms we may explain radiant energies without ascribing volition to electrons, and without making mechanical principles inconceivable.

Energy-emanations may be due to different manifestations of the energy-principle. A balloon will burst when mashed too hard, and it will explode when put into a vacuum. In the latter case the internal motions, then unbalanced as to the exterior forces of restraint, tear the cover apart. The radiations of light, when two bodies collide, commence in a fashion similar to the radiations of the air-molecules from the balloon burst by a blow, and are translated in a fashion similar to the translation of the sound of the bursting balloon. The radiations from uranium, however, are due to the change in the general average of the energy-delivery from the outside—a general change which is caused by Evolution. Uranium erupts because the momenta of the parts within the former atomic structures can no longer balance the increased average of the external energy-deliveries. A new balance with the new energy-expression of the general environment must be reached, and this is attained by the emission of some of the parts.

Let us try, then, to explain all forms of unbalanced radiant energy from atoms as beginning from a condition of energy-unbalance within the atomic structure—but a condition of unbalance itself originated by unusual energy-receipts from the outside. Because an unusual amount of exterior energy is received from some direction, (or from all directions) some of the atomic corpuscles are driven to move beyond the bounds of the normal atomic structure. Corpus-

cles are radiating from an atomic structure, we believe, when it gives us the sense-data known as radiant light, but the light-effect is obtained only when the radiation repeats in regular series—that is, when emissions occur at certain regular intervals, and only when these radiations from the atomic structures represent the emissions of masses smaller than electrons. X-rays, as they are called, leave an atom when it is subjected to the blows of a stream of electrons, and we are informed that this radiation is:

> identical with visible light except for the frequencies which are involved. Heat rays, light, ultra-violet rays, X-rays, the gamma rays which have been mentioned as sometimes accompanying electron streams from radioactive substances, and the Hertzian rays used in radiocommunication are all radiations of the same character except for the frequency of the vibrations from which they originate. Except for heat rays, which are believed to be due to motions of atomic systems, and except for Hertzian waves which are due to surges back and forth of electrons in wire systems which are conducing alternating currents, all other radiations are due to vibrations of the electrical elements within atomic systems.[1]

If, however, these radiations are really induced by the blows of a stream of electrons, then they cannot be due to "the vibrations of the electrical elements". The oscillating vibrations of matter-bodies are themselves due to exterior blows, for they are not self-induced, and the ability of vibratory systems to give off unbalanced energies to other systems, while still continuing to vibrate themselves, is proportional to the unbalanced energy received from some exterior and "absolute" source of power. Since, however, the smallest amount of energy obtainable from the disruption of an atomic structure through radiation is invariable in its quantity,—as is proved by the supposed fact that all the energy-receipts of certain frequencies are exact multiples of a uniform minimum quantity of energy,—the smallest quantity of energy (Planck's famous quantum, or constant-

[1] John Mills: *Within the Atom,* pp. 115–6.

quantity, h), must stand for a universal energy-phenomenon of striking significance. We shall, however, postpone our consideration of this to Chapter XXX. Here we are dealing with another matter.

We have learned that a rhythmic series of blows from that which we may perhaps assume to be the smallest bit of matter, when moving at a certain typical speed, and with a certain interval, delivers to the retina of the eye that impulse-series which is mentally sensed as a certain colour of light. It appears, too, that this smallest particle delivers to our bodies the series of blows which, when received at other intervals, we realize as radiant heat. And, since the energy-delivery of the unit blow is a constant-quantum, or h-quantity, the delivery of radiant energy varies in quantity in a direct proportion to the frequency. The reception (and also the absorption) of radiant energy by atomic structures is also in multiples of this same quantum of energy.

Now the quantum of radiant energy is less than the momentum delivered by an electron when moving at approximately similar velocity. The mass of the particle (or self-contained structure, which ever it is) delivering the quantum-blow must therefore be less than that of an electron, and the electron must therefore be composite. The fact that the electron is compressible confirms the belief that it is composed of smaller bits. Since, however, the electron is a composite structure, it should lose some of its parts whenever it is unusually bombarded from one direction. The movements of these relatively large and heavy electrons, then, give us the blow-effects of electricity, whereas light appears to be derived from the intermittent blows of smaller bodies. And since the energies of light, radiant heat, and electricity, are delivered at approximately the same velocity, we may assume that the average mass-density of the structural formation which actually does the striking (a wave-front whose width is defined by the limited oscillations of the separate parts of the wave-structure) is approximately the same in all these cases.

When the electron is in energy-balance we may assume that it presents a formation of smaller parts which in the

average may be regarded as symmetrically arranged. These parts oscillate in the average within definitely limited bounds, and these limits are themselves established in the average by the energy-situation surrounding the particular electron-structure. Unless the structure were sufficiently compact it could not, without disintegration, resist the usual energy-deliveries which it receives. All typical formations, whether electrons, atoms, molecules, or chemical compounds, are in some respects alike. At least they respond to the same general environmental principles. The parts of all of them receive their energies of motion from the environment; they are all composed of the same type of oscillating unit parts; and they all exhibit, in the average, equal energies within corresponding volumes. From day to day these typical volumes represent and display substantially invariable bundles of physical properties. We designate the larger of these structural formations as "elements", and we rely confidently upon the principle that they will invariably deliver similar energy-effects to our organs of sensation. Many elements are even regarded as forever permanent and indestructible.

The more or less dependable uniformity in the average energy-receipts that we have reason to anticipate from the elements, affords us what is perhaps our most important reality—our most practical means, that is, of acquiring approximate knowledge of what has taken place and of what may be expected to take place. It justifies us in analyzing and formulating the routine of the conventional happenings. In all such cases a proper formulation of the average result of the routine of the past will apply approximately in the same average fashion to the routine that may be expected to take place in the future. The formulation of this dependable routine in typical atomic relationships may often be set up in simple mathematical terms, and this symbolic statement then affords us a valuable short-cut method of determining the approximate average results that may be anticipated in a future experience of the same average sort. The factored formula obtains its practicability from the reality of the dependable *order* that obtains, but it is never completely reliable. It is a particularly useful but not an infallible or com-

pletely accurate means of interpreting the grosser events. It does not apply to the particular, nor does it apply *precisely* either to the past or to the future energy-situation. Let us not unduly value it.

Our reliance upon these typical formula-patterns (or "laws" of routine) for certain usages is fairly justified, as we say, because the generalized expression of many types of order *is* fairly assured. In many classes of phenomena the future will almost precisely repeat the average of the past. Nevertheless, merely because this assurance is well placed when one treats with engineering problems of the usual sort, we must not conclude that the formulations are *ever* exactly true. The general mechanical rules summarize merely the *normal* energy-deliveries that we may expect to receive *in gross* in exactly similar situations, and this statement itself is true only when the situations are averaged through many units of time and space—that is, through a long series of energy-events. Moreover, as the general energy-situation changes it will be necessary to modify the factors of the generalized formulas.

Let us think, then, of electrons and atoms as typical matter-structures. Both are composites, and both are composed of smaller bits. And we may assume, too, I think, that neither the smallest bits nor the composite structures make use of appreciable volitions or foresight as influences creative of other activities. They are not able to display free-will to this degree. Let us not attribute to the inert parts of atoms a knowledge of mathematics, therefore, but let us claim that electrons expand in their structural formation within the atom merely because they have received more energy from one direction than from another.

Whenever the electron structure has received unusual energy from some one direction, parts of the mass of the electron must leave their usual structural bounds at least far enough to deliver energy unusually in this same direction into the volume alongside. If this unusual pounding from one side does not persist, the same number of the quanta of energy as ordinarily represented in the energy-volume of the normal structure (those energy-particles, indeed, that have

departed an unusual distance from the energy-centre of the organization) will soon be returned to it. If the expansion of structure has not gone too far, the same identical oscillating bits of matter will be returned to the organization; otherwise, their places will quickly be re-filled by similar bits of matter from the environment. If the full number of particles (those representing the normal energy-volume) were not returned to their former compactness of volume when conditions became normal, the structure could not maintain its symmetrical formation, its repeating internal cycles, its order, its energy-equilibria with the environment, its fair measure of dependability, its seemingly regular internal rhythms, its consequent ability to radiate regular series of reflected energy-impulses, and thus, in general, its ability to display constantly the same set of physical properties. Only thus could it be that which it is when not being pounded unusually from one direction—namely, an orderly part of an orderly energy-world.

Only thus, in turn, can the atoms be potentially ready to deliver the constantly regular (even though unusual) sensational impulses of reflection whenever the structures are unusually collided with. Only thus can one of the elements display its usual light and colour when subjected to the normal sunlight. Only thus can incandescent elements display constantly the same spectral lines; and only thus does the atom fill an orderly part in the structure of its element. Only thus does the universe appear to us from day to day with an order which seems almost changeless when largely viewed.

When an unusual energy-delivery is repeatedly received from all directions by an energy-volume consisting of a certain number of oscillating parts, it is possible that the structure will be unable to maintain symmetrical organization through the process of slightly contracting or expanding its average bounds. If the increase in the average external pressure should be too great, and if it is repeated long enough, the formation will expand to such bounds that it may be unable thereafter to retain its former number of parts. In such case, the old structure will be replaced by a new one of simpler form, one which can receive this greater

amount of exterior energy while still retaining (in the average) its symmetrical and balanced formation. When the atom of lead appears in place of the atom of radium, we perceive the results of such a process of simplification. The structure is simplified, we believe, in answer to a repeated increase in the average energy-receipt from the outside.

Radioactivity is never "spontaneous", therefore, and never created by the independent free-will or volition of the material parts of the body. The old structure can no longer be maintained, and this is so because there has been a change in the average quantity of energy delivered from the outside. A new formation must now be constituted if the energy-equilibrium with the environment is to obtain. All of the atomic formations are being maintained in the midst of repeated exterior blows, and these symmetrical, orderly, and fairly stable groupings in the midst of motion are made possible because these exterior energy-impulses are themselves regular and orderly.

Orderly motions (in the average) everywhere in the universe, therefore, permit the continuance of symmetrical organizations of some permanence, and within certain average bounds. They permit also the repeating internal atomic cycles of regular pattern. The general energy-order even affords us our appreciation of order. It permits some matter-particles to radiate (and others to receive) regular series of energy-impulses, each delivery or receipt being expressed in multiples of the unit of radiant energy. Thus it is that the elements reflect striking matter-bodies in consistent fashion.

Even the structures of our organs of sensation, composed themselves of usual atoms, are themselves orderly. This fact, in turn, permits us to obtain those rhythmic impressions that build up penduliferous swings in certain parts of our body—oscillations sufficiently expanded in space and time to give us appreciable "sensations". Thus our eyes can "sense" light-rhythms and our ears can "sense" sound-rhythms.

The presence of this general order also permits us to identify the exterior mechanical environment from its typical messengers. It permits us to reason to mechanical cause

from sensed effect. And, because in certain relationships at least, there is this dependable order in the motion-relationships, we can see why it is that, as the average amount of mass-motion in the universe changes, there will be a corresponding re-ordering of the more complex structural formations. This simplification of structure, however, must not be regarded as "spontaneous" or as volitional. The power creating this change is not derived from within the physical inertia of the atomic configuration that is being altered. Rather the change is forced upon the structure from the outside. The alteration represents a created change in the general order.

Passing by these details, however, we believe we have the right to assert that the presence and requirements of this equilibrium *with* energy which Reason calls for, and which Vision answers for, condition and explain the mechanics of the universe.

Because they cannot understand the activities of the electrons within the atom, some physicists seem almost willing now to deny Conservation for these tiny spaces. They are torn between two loves—mechanical determinism and the need of explaining light-radiations as energy-waves of ether emanating from "spontaneously" moving electrons. Thus Professor W. L. Bragg, of Victoria University, England, in a discussion of atomic theories, remarks: "We may have to abandon our ideas of conservation of energy in the atomic world, and regard the principle as an average effect."[1] This remark corresponds with the statement of Sir James Jeans already quoted.

If, however, Conservation does not apply to the interior volumes of atoms, one must assume the motions of the atomic parts are created by a principle outside of classical physics. How, then, can the energy-expression of the universe remain constant in the classical sense? The classical physicist must assume that the energies created within the atoms (created there in terms contradictory of Conservation) are somehow, later on, expressed outside of it. Such an assumption is unreal, however, for it is virtually based on the concept that

[1] *Yale Review,* July 1923.

Time itself is the agent which, later on, equalizes the energy-contents of the universe in conformity with a general principle of Conservation.

Even though the general energy-principle may be unbalanced momentarily, it may be balanced through time, they seem to think, and, conceiving this, they then argue that the principle of mechanism may be consistently regarded as satisfactorily maintained provided only that it reaches this final balance. The *fact* of unbalance in the present is regarded as *no fact*, provided that Time will introduce a later compensation. Yet, after all, the principle of sufficient Reason informs us that the breach of a principle in one place for even one moment of time or space breaches it universally for that same time—and breaches it significantly and "absolutely." The conventional theory of Conservation must therefore be abandoned everywhere if it is abandoned for certain intervals within certain volumes. The energy of the matter of the universe must then be attributed to a mental Power that independently creates and recreates the motions of matter-bodies. Reason perceives no alternative.

The physicists encounter other difficulties in their theories of radiant energy. After a discussion of the unrealities of the conception of an ether in which light-vibrations might occur, Professor Eddington says:

> . . . the ether has ceased to take any very active part in physical theory and has as it were, gone into reserve. A modern writer on electro-magnetic theory will generally start with the postulate of an ether pervading all space; he will then explain that at any point in it there is an electro-magnetic vector whose intensity can be measured; henceforth his sole dealings are with this vector, and probably nothing more will be heard of the ether itself. In a vague way it is supposed that this vector represents some conditions of the ether, and we need not dispute that without some such background the vector would scarcely be intelligible—but the ether is now only a background and not an active participant in the theory.
>
> There is accordingly no reason to transfer to this vague background of ether the properties of a material

ocean. Its properties must be determined by experiment, not by analogy.[1]

The physicist finds his theory of radiant energy so inconceivable that he is obliged to assume that there is an ether which transmits radiant energy, but, at the same time he must endow this medium with unreal and unphysical qualities. Eddington says, for example:

> There need not be anything corresponding to permanent identity in the constituent portions of the ether; we cannot lay our finger at one spot and say "this piece of ether was a few seconds ago over there." Without any continuity of identity of the ether, motion through the ether becomes meaningless; and it seems likely that this is the true reason why no experiment ever reveals it.[2]

We must assume, then, that ether is something real, but without a "continuing identity", yet with enough continuing identity to serve as a background for electromagnetic vectors.

It is often difficult to understand the meaning of the language of the twentieth-century scientist. Modern physics and metaphysics seem to have attained the common ground that Herbert Spencer found for religion and science—they both accept the unknowable. It may be added also that quite often they subscribe to the unreasonable.

Before ending this chapter let us consider a little more of the modern atomic theory. Atomic structures are able to resist the aggressions of other bodies. They resist compressions. Yet, how is this possible if the atomic parts are not in contact with one another?

The planetary electrons of each atom are supposed to revolve around the central nucleus, and the speed of revolution is not supposed to be retarded by contacts with other atoms. The orbital curvature is supposed to be due solely to the attraction of the nucleus. One orbital speed only is appropriate for one certain average radial distance; hence the

[1] A. S. Eddington: *Space, Time and Gravitation*, pp. 39–40.
[2] *Ibid.*, p. 40.

electron tends to stay at this distance (it is believed) and offers resistance to being shoved closer to the nucleus. This resistance is supposed to account for what is known as the "hardness" of the atomic structure. If the different electrons could be shoved easily into the central sun the atoms would have no *structural* hardness. There would be only the hardness of the central mass. Atoms do have hardness, however, and the resistance of the revolving electrons to orbital change is supposed to be its explanation by those willing to accept the Bohr hypothesis of atomic structures.

Our idea is different. We do not believe that electrons revolve without contacts about the nucleus, or that they are held in their orbits only by "attractions", or that they never reach average bounds where their motions are reversed by restrictive blows. We have advanced other explanations of the fair permanence of the atomic structures. We can agree, however, that each element has its own typical atomic design, for it seems that, for a certain number of parts moving at certain speed, only one structural formation is appropriate. Only this one average arrangement will be maintained fairly permanently when subjected to the usual series of blows from the outside. And, when a certain number of hydrogen-nuclei have grouped themselves into a certain structure, one range of average movement and one velocity of the oscillating parts will offer the most perfectly balanced resistance to the blows of other masses impinging from every side. But, when this resistence is perfectly balanced through average time the structural formation may be maintained indefinitely. For the balance to be maintained, however, each formation of hydrogen-nuclei must have its own characteristic average energy-volume—or typical volume-density, as we may term it. By movements within certain limits,—within certain volumes, that is,—and at certain speeds, the parts of the structural formation of an atom will (in the average) deliver momenta towards the external particles with force just sufficient through time to balance their aggressions. The average structure of the complex atom cannot be changed, therefore, unless the environment changes.

Nor do we believe that the single electron associated with

each hydrogen-nucleus is really a planetary body, as the Bohr theory postulates. The electron which temporarily appears to be associated with the hydrogen-nucleus seems to us to be nothing more than that one of those corpuscles which strike against the nucleus from the outside with sufficient energy and sufficiently often to keep the oscillating parts of the nucleus itself from dissipating. The nucleus is struck by one corpuscle after another from different directions. A corpuscle is associated in the average with the nucleus as an energy-agent once in so often, but this corpuscle is a visiting and haphazard stranger, and is not a permanent boarder in that house. In one sense, through average time, one electron *is normally* associated with one hydrogen-nucleus—but not as a planet. The only balanced, symmetrical and fairly permanent part of an atomic structure is the structure of the nucleus itself.

Now if one will grant that there is normally an atomic energy-volume which is in equilibrium with general energy, he will admit that an unusual density of structure must temporarily be created along a certain axial line by the unusual receipts of exterior energy along this line from one or more directions. If, however, the unusual energy-delivery is received simultaneously from all directions, all the structural parts of the grouping will be brought abnormally close together. As long as thus abnormally compressed within smaller than normal average bounds, more than the normal average amount of energy must be delivered to this grouping from the outside to keep the parts oscillating even though still remaining in the average within these unusually restricted bounds. As the bounds of the structure are less extended, the movements of the particles will be subject to more frequent reversals, and, therefore, more energy will be consumed in accomplishing these restraining reversals. But, when thus compressed abnormally, the structural formation, regarded as a whole, is in a new balance with the abnormal energies as then being delivered to it from the outside. It displays then, as a self-consistent energy-volume, an unusual expansive pressure. This is the well known experience encountered when any gas is unusually compressed.

In its resistance to unusual compression, therefore, the structure of an atom exhibits "hardness" in the same manner as a gas balloon. In every structure, solid, liquid, or gaseous, when the parts are pressed closer together than normal the average part will move less than the usual distance within the formation before its motions must be reversed by the use of energy, and, solely for this reason, the normal energy-delivery from the outside will not keep its formation thus unusually restrained. Only an unusual use of force is capable of maintaining an unusual density within a structure whose parts are oscillating—as the parts of all composites do. The usual composite may therefore be called "hard" to the degree that unusual force is required to compress it to greater than usual compactness. Every composite structure of the earth, because it receives some energy-deliveries from the outside that give motions to its parts, is relatively "hard", but the final degree of relative hardness depends upon the formation and upon the mass density of the parts.

Let us suppose that an enormous hand should attempt to squeeze the moon closer to the earth. There would be resistance to this change, for the earlier orbital relationship of the moon with reference to the earth represents the successive positions that it *must* assume in reaching its equilibrium with the unbalanced energy then converging upon the earth. We may therefore say that the earth-moon orbital relationship offers resistance to greater compactness in the sense that more than an unusual amount of energy converging on the earth *must* be displayed if the bounds of the moon's motion are to be further limited. In this respect the earth-moon relationship as a whole subscribes to a principle of energy-balance similar to that maintaining the structural bounds of the air-balloon—as well as the limited structures of atomic systems and parts of systems.

There is, however, according to one view, a difference between the motions of the gas-molecules of the balloon and the motions of the worlds of the earth-moon system. The gas-molecules, except for their contacts with other particles of matter, would oscillate from cover to cover of the balloon in straight lines, whereas the moon revolves about the earth in

an approximate ellipse, and stays almost constantly on the oval perimeter of the earth-moon orbit. Even so, the cycles of motion do correspond to the same general principles, and more than the usual energy-delivery would be required to compress the earth-moon system to a smaller mean diameter. The amount of the extra energy required to accomplish a certain amount of additional compression is the measure of that which we may call the "hardness" of a particular energy-volume that is being "controlled" by certain mass-movements. Hardness is one of the attributes which a mind operating the giant hand would discover as a property of the earth-moon system when it attempted to increase the compactness of the system.

Suppose, however, the giant person did not try to compress the orbit of the moon, but stood a few million miles away and looked at her. What would her colour be? Moonlight is reflected sunlight. If the moon were made of carbon the sunlight would be reflected from the carbon sides, and the quality of the sunlight would be altered by this contact. When sunlight strikes and reflects from an atom of carbon its new character will depend upon the changes made by the meeting of one rhythmic energy-series with another. Part of the particles whose unusual motions transmit the sunlight may temporarily be retained by the carbon atoms, or, part of the unusual energy of motion of the light-corpuscles may temporarily be added to the elements of the moon. But, more likely, the formation of the series of light-impulses will be altered in breadth or frequency by the collision. In any event the light will rebound from the carbon atom with altered energy-properties, and when, later, this light-formation strikes the eye of a distant observer, it will, as we have said in earlier pages, give to the organ of vision a changed colour-sensation.

The character and colour of the sunlight reflected from an atom, depend, therefore, upon the changes made in its energy-series-and-properties by the energy-series-and-properties of the oscillating parts of the atom. As the atoms have distinctive structures—and also distinctive internal rhythms—the reflected sunlight will be typically different when reflected

from different atoms. Sunlight reflected from a certain element has its own individualistic colour-sensation, but this is so only because sunlight rebounds from each of the elements with characteristic alterations in its own energy-properties. In fact, all the sensations derived from matter-groupings, and, therefore, all the reality they have for us as sources of typical sensations, depend upon the changes which one unusual energy-series makes in another when the bits of matter composing them come into contact.

Taste, tone, smell, hardness, colour, even heaviness, depend upon the properties (and especially upon the frequency) of the energy-series which deliver their impressions to our bodies. The contact between our bodily parts and the parts of the exterior object which is to be "sensed" (and thus identified to the mind as a certain type of energy-manifestation) may be direct, as in the sense of touch (hardness, temperature, or heaviness), or it may be transmitted through a chain of contacts (colour, radiant heat, and perhaps smell or sound), or it may be a translation undisturbed in quality (if not in quantity) straight from the object to us as a certain typical energy-series (the bullets from a rifle). In every case, however, the energies are delivered to us as the blows of inert masses.

The unusual energy-series represented by radiant heat, light, and smell, often seem to reach us directly—that is, without reflection from other bodies having structure-parts moving in opposed directions. The quality of an energy-series often seems to remain the same as it was when it started from the bounds of the structure that is giving off the sound, colour, or smell; but, even if unchanged in quality of sensation, there is necessarily so much unusual contact with other matter (in the average at rest) on the journey that the energy-series of the original emanations will be dissipated. It will arrive typical in frequency, perhaps, but reduced in amount. Even the energy-radiations that reach us as sound, heat, colour, or smell, however, have (as we have noted) as their prior cause an unusual energy-delivery to that body which appears to us then as hot or odorous. Just as the colour of the moon is not represented solely or typically in the usual

atomic activities of the structures of the moon, and just as the radiations from incandescent gases do not arise spontaneously from original energy sprouting within the gaseous structure, just so we may be sure that the sensations of heat and smell never *originate* in the object which seems to be the source of the sensation. All of our sensations are derived from the "absolute" cause of the general energy of motion that everywhere is being manifested, but we would have no unusual energy-receipts (and, therefore, no sensations) except that unusual energy-manifestations began within certain volumes, and were transmitted to us directly or indirectly. In the corpuscular theory of gravitation we attempt to identify this unusual beginning of unusual energy-delivery.

The earlier source of all our sensations, therefore, is to be found in the Power which first causes the restrained motions, which thus *creates* the structural formations of some permanence (and the ordered systems harmonizing with the general energy-requirements), and which, finally, creates the change in the usual energy-order. Each structural formation that transmits unusual motion, however, has its own characteristic-energy-part to play in respect to the energy-series finally delivered by reflection from it to another contiguous energy-volume; and as this part is played in consistent fashion under like conditions, we can judge the energy-quality, even of the reflectors, through an interpretation of the way the original energy-impulses are changed by the reflection. Thus, for example, we become acquainted with the elements of the moon by an analysis of the properties of sunlight reflected from it.

All sensations, as we note, when broadly viewed, are derived from mental associations with the *unusual* motions which accompany Change. All unusual energy-delivery, however, does not necessarily result in a permanent change forever appreciable. A mashed balloon, when released from an unusual weight may be exactly as it was before the weight was placed upon it. Only during the process of the change will the unusual energy-condition be appreciable.

Our receipts of sensation from the elements are fairly uniform because these atomic structures (at least during the

short period of one man's life) are composed of uniform building-blocks which remain in fairly stable and dependable formations. The variations in conditions are usually indetectible. Except for this dependable stability of structure during a life-time, and the consequent constancy of dependable order in the phenomena around us (a general principle of order which itself flows from the regular delivery of motion to the matter of the universe from a source outside itself), the colour of the moon might be red one moment and green the next. Or, the moon might be heard rather than seen, or soon we might not be able to sense it. More and more as we look to the principles of universal energy-deliveries, and of the internal energy-equilibria flowing from it, and especially exemplified within certain structures, and of the Evolution that follows as a planned result, we find ourselves satisfied that our assumption of reality for these principles is sound. We almost seem justified in calling these principles "facts," because, more and more, they dissipate the mysteries and thus prove themselves true.

The structure of the hydrogen-nucleus stays in perfect balance with the energies delivered from without in the sense that the most severe blow seems incapable of causing the emissions of electrons. This does not signify, however, that it is a solid. It is doubtless composed of separated parts, and the day will probably come when it will be decomposed in response to a change in the energy-deliveries against it from without. This decomposition will take place in a fashion which the scientist of to-day would describe as "spontaneous." Indeed, the hydrogen-nucleus now appears to emit quanta in its heat-and-light-radiations, but if any parts pass beyond the bounds controlled by the structure because there has been temporarily an unusual energy-receipt along one axis, they are doubtless returned to it fairly quickly after the unusual energy-demonstration is past. The energy-harmony of the structure of the hydrogen-nucleus with its environment is undoubtedly far more perfect than that of the alpha particle, which, as we have learned, is composed of four hydrogen-nuclei. A single marble has a more compact and a more perfectly balanced formation than four marbles in a group. Yet,

the parts of the radiating alpha particle stay together well enough to prevent the decomposition of the structure into its four hydrogen-nuclei. They do not appear to disintegrate so far as the scientists are able to trace them.

Bertrand Russell says: "It is a curious fact that in radioactivity the particles thrown off by the nucleus consist always either of electrons or of helium nuclei (alpha particles). Not only do we never find nuclei of heavier elements than helium thrown off, but we never find hydrogen-nuclei." [1] Why curious? The fact proves merely that an atom more complex than the radiating alpha particle (which perhaps radiates more easily than the hydrogen-atom because it is an unsymmetrical structure, offering less than the normal exposure to the external forces of restraint) is not compelled to disintegrate into its hydrogen-nuclei parts when it receives abnormal energy. The complex atoms maintain their energy-equilibrium with the environment most easily and naturally by parting with groups of four hydrogen-nuclei.[2]

The scientists admit other facts which seem to prove that all radiations, even light and radiant heat, begin as the emissions of matter-bodies. When the unusual energy-disturbance accompanying light-radiations comes to an end, the structure is then capable of absorbing energy-masses. This capacity of absorption indicates that masses have previously been ejected from beyond the bounds of this structure into the general pressure-pool. And then, too, whenever a body loses radiant energy it loses measurable mass. Thus, when electricity leaves a body its mass is lessened. Mr. Russell says: "When a body absorbs radiant energy, its proper mass is increased; when it radiates out energy, its proper mass is

[1] Bertrand Russell: *The A B C of Atoms*, pp. 119–120.

[2] According to the concept suggested a few pages back, the electrons supposed to be associated with atoms are not planets after all, and the energy-effects attributed (under the Bohr hypothesis) to such planetary electrons, are really derived from the average blows of corpuscles impinging from outside the atomic structure. According to this view, the alpha particle is associated with only two electrons merely because its four hydrogen-nuclei are turned edgewise to this delivery of external energy. This reduction in the average pressure on each of the four hydrogen-nuclei of the alpha particle from this particular direction, as compared with the pressure against each of the hydrogen-nuclei when in some other formation, may account for the fact that the alpha particles, rather than single hydrogen atoms, are emitted from radioactive elements.

diminished." This radiant energy may be heat, light, or what not. If, then, its "proper" mass may be regarded as akin to the mass of matter of the conventional kind, this statement signifies that these radiations consist of the emissions of real masses. Mr. Russell remarks that "the proper mass" is a genuine property of a body, not relative to the observer. As a rule, the proper mass is constant, or very nearly so, but it is not always strictly constant."

Here the scientist seems to try to escape the admission that all energy-radiations are radiations of typical mass (or matter) beyond the normal energy-structure by saying that the grand exception to constancy of "proper mass" occurs during the phenomena of radiation. In this way it may be asserted that a body radiates mass but does not radiate real mass—or, at least, radiates mass without radiating matter. Mr. Russell remarks mysteriously that "The loss of mass involved (by radiations) is loss of proper mass, and is quite a different kind of phenomenon from the variation of measured mass when an electron changes its velocity."

Professor Einstein, in his special theory of Relativity, attempts to associate the idea of mass with the idea of energy by saying that inertial mass changes as the energy of relative motion changes. He denies us our idea of a conventional smallest bit of matter which has a changeless inertia of its own, which may be "charged" with motion from the outside, and which usually transfers part of its motion to another particle in its path rather than disrupt. We are not permitted to use this simple definition of matter and of its fixed quality of inertia, but are asked to believe that inertial mass is a changeable attribute of matter, and that the effect of motion on this inertia-attribute increases faster than the motion (or velocity) increases. The energy-effect of the inertia of a *moving* mass is supposed to enlarge faster than in a ratio to the amount of its movement. Einstein asserts that the kinetic energy of a body (its $\frac{1}{2}mv^2$) increases faster than the velocity squared (v^2) increases. Then, says Einstein, the m itself, or the inertial mass (and, perhaps, the matter also) of a body, must increase faster than v^2 increases, for otherwise its $\frac{1}{2}mv^2$ could not increase as it does. In

fact the inertial mass (m) is supposed to increase much faster than velocity increases. Inertial mass, therefore, is not a constant, but varies with relative motion.

This reasoning is simple enough, and inconceivable enough also, but before one lets his mind accept a theory so contrary to the usual point of view, he should be sceptical of every premise upon which it is founded. Is inertia really a changeable attribute as viewed from the standpoint of the matter-body itself, and if so, what is the process that changes it, and what is the source of the power of the process?

Mr. Russell, in interpreting Einstein's theory, says that "if the body is moving with a velocity which approaches that of light, the measured mass increases, and as the velocity gets nearer to that of light, the measured mass increased without limit." This means that the "measured mass" reaches infinity at the velocity of light, and that an infinite energy is required to give a body the velocity of light. Mr. Russell softens this statement a little by saying: "this increase of mass is only apparent; it would not exist for an observer moving with the body whose mass is being measured." But what about the energy of motion of the inertia of the mass (that property which we believed matter always possesses whether moving or at rest in respect of other matter), would that be "only apparent" also? And what does he mean by "only apparent"? Does he mean that there is only a seeming change in the measurement of the matter, and not a real change? Does he mean that this change is or is not a fact?

And what about the matter of the body? Is the matter-quality independent of the mass-quality, or can a body lose any type of mass-property without losing its matter-property? If, from any viewpoint, a phenomenon or a property of a reality is a fact, then it cannot be "only apparent." Either the actuality of $\frac{1}{2}mv^2$ remains proportionate to a constant mass (to a constant amount of inertia of the moving matter) and a changing velocity, or it does not. If I am standing still, and v is the velocity of light, is the momentum of the mass m moving at v speed in reference to me always mv, or is it something else?

According to Professor Michael Pupin, Professor Thomson has suggested that the electrons possess an inertial mass on account of the electrical energy stored in them.

> This suggestion led to the generalization that all electrical energy has mass possessing not only inertia, but also gravitational action. Who does not know today of this generalization, and who has not heard of Einstein and his verified prophecy that a beam of light will be deflected by gravitational force? A beam of light represents electrical energy, and electrical energy is gravitationally active just like any other mass considered by Newton. A star radiating light radiates electrical energy, and, therefore, it throws out to us a part of its own mass. [1]

This seems to mean that energy-radiations consist of mass, and perhaps of matter of the usual definition. By speaking of energy as synonymous with mass, by introducing an inconceivable definition of matter and its mass, by confusing all previously held concepts, and by inferring that somehow the impossible can happen—namely, that mere motion can effect the amount of the inertia-property of matter, and that the energy of matter in motion can vary in a way which is not in some direct proportion of the motion—these ingenious persons, with some of their convictions unshaken, make many incomprehensible assertions.

We do not believe that either the measured mass or the inertia-property of matter increases with its velocity. As the motion of an object increases, the product of its inertial mass by its velocity (its real energy) increases in a steady ratio. How can momentum increase in some manner disproportionate to velocity? Where does the additional momentum come from? What if energy-transmission is due only to inertia-contacts? What if all "attractions" are unreal; what if no forces are delivered by "pulls at a distance"; what if no energy is delivered by an imponderable ether; what if all radiations represent, at their beginnings at least (until, that is, the unusual energy-expression in this direction can be taken up and carried on by another object having

[1] Michael Pupin: *From Immigrant to Inventor*, p. 381.

mass), the emissions of masses of the conventional kind; what if unit-energy is directly proportional to relative speed whatever the velocity may be; what if all these things be true—as they well may be—and what if there is besides a force-equilibrium in the universe? In such case there may well be a maximum speed for the smallest bit of matter in the universe, and it will be quite impossible for the multiplied contacts of other bodies (even an infinite number) to give an impulse which will increase this speed. This thought is simple, as we have said before, and if this meaning is given to the statement that an infinite energy is required to give a velocity of energy-transmission greater than that which is the maximum of the universe (the velocity of light-energy), we can readily subscribe to it. This fact does not justify us, however, in saying that the measured mass of a body increases tremendously as its velocity approaches the speed of light.

Later on, when interpreting the mechanical formulas involving the transferences of motions by contacts, and when considering the creation of velocity by repeated physical overtakings and collisions, we shall find that the energy-requirements increase rapidly as the speed of the accelerating body approaches the speed of those bodies which are being used in an effort to shove it faster. This principle is not in the least mysterious. Indeed, it is almost self-evident.

We believe, then, that the imponderable ether-continuum is a myth, and that radiations, such as light, radiant heat, and X-rays, are now known to be, represent emissions of typical matter retaining possession of its typical inertia-property, and that the quantity of inertia is constantly proportional to the matter-quantity. Mr. Russell says:

> As everyone knows, light consists of waves. . . . Sound-waves consist of vibrations of the air, or of whatever material medium is transmitting them, and cannot be propagated in vacuum; whereas light-waves require no material medium. People have invented a medium, the ether, for the express purpose of transmitting light-waves. But all we really know is that the waves are

> transmitted; the ether is purely hypothetical, and does not really add anything to our knowledge. . . . We do not know what it is that undulates. We only suppose that something must undulate because we find it difficult to imagine waves otherwise.[1]

If light is a wave of nothingness, it is difficult to conceive how the nothingness of light might be attracted by the sun; yet it is well known that the light does bend towards the sun as it comes to the earth from a distant star. It bends, indeed, more than it ought to be bent by the action of gravity alone on a moving mass. Must we imagine, then, with Einstein that the space-time around the sun is curved by the distant action of the sun's mass sufficiently to bend light to this extent? May waves of ether-nothingness thus curve when empty space-time, as thus influenced, tells it to do so?

The modern electromagnetic theory does not convince us. If electrons or smaller particles do not give the blows of light, then we can conceive of nothing else that might do so. Thoughts about "lines of force" do not enlighten us. Sir Isaac Newton inclined to believe that light-energy was due to a mass-impact, but, while some of the modern scientists have reached this same conclusion, most of them deny that light represents the movement of matter. Mr. Russell remarks that "the evidence that light consists of a wave remains quite unshaken; it is derived from the phenomena of interference and diffraction." But the wave of what?

Our theory, then, if it is to prove acceptable, must not be incompatible with the phenomena of interference and diffraction. These principles must be confirmed on the basis that light begins as a mass-radiation if the strong inferences already drawn to this effect are to receive final approval and support.

We perceive the need in physics of some theory by which the conflicting opinions may be harmonized. The physicist have established many generalized facts, but have not synthesized, particularized, nor adequately rationalized their experiences. And the theories built upon Conservation have

[1]Bertrand Russell: *The A B C of Atoms,* pp. 40–41.

become unreal. Even so, the professional scientist often despises the opinions of the non-professional theorist in the way Prince Kropotkin intimates: "Yes, our metaphysician is a blind man hunting in a dark room for a black hat which does not exist."

But who, after all, is this blind man who hunts in the dark? Is he not the physicist who tries to explain significant experience on the basis of mechanical insignificance; and who postulates dead Conservation as a background for active motion and accomplishment? The scientist may hunt unavailingly within Conservation for his explanations: Explanations can never be found there: Only vagueness and incomprehensibilities will reward him: Theories must be grounded otherwise: We must establish a sounder premise. But what shall his premise be? Let us consider the hypothesis of an absolute Evolution,—of a Change that is caused by motions, both the cycles of motion and the Change being opposed to the concept of Conservation,—and see then if the way into the atom is not made clear. Perhaps we may then see clearly, advance confidently, and grasp Truth by the hand.

In the next volume we shall boldly commence our criticism of the rules of physics. As a first step we shall be obliged to consider the reality of the mathematics which the scientists use in making their proofs about such matters as the nature of orbits. Here we reach the hard heart of our discussion.

End of Volume I

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